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Limited Access Alternatives for the Pacific Groundfish Fishery

Daniel D. Huppert, editor

U.S. DEPARTMENT OF COMMERCE
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PREFACE

Limited entry became a serious topic of discussion in the Pacific coast groundfish fishery in 1984, a year of economic strife in the trawl fleet which came just after a period of rapid expansion. Between 1976 and 1982 annual shoreside landings more than doubled, the foreign trawl fishery shrank to insignificance, and the "joint venture" fishery was born and prospered. To accomplish this growth in landings, the groundfish trawl fleet expanded from fewer than 300 to over 440 vessels. Economic conditions, however, proved incapable of sustaining the growing fleet of new, modern trawlers. Neither the Pacific coast rockfish stocks nor the traditional flatfish and sablefish stocks provided the needed room for expansion; nor did the Alaska groundfish fishery absorb the new vessels quickly enough. Economic returns to trawl vessel operators, especially those with big mortgage loans on new vessels, fell below levels needed to justify the investments. Many vessels failed financially, and lenders began repossessing vessels from owners with delinquent loans.

During 1982, the Pacific Fishery Management Council was petitioned by a group representing trawl fishermen to adopt an "immediate emergency moratorium on all groundfish trawling". Also, the Council's groundfish management team and Scientific and Statistical Committee noted that limiting entry to the fishery should be considered as a management tool. In the fall of 1984 the Fishermen's Marketing Association in California and the Coast Draggers Association in Washington state jointly proposed (see Appendix A) that each of the Pacific coast states create a trawl vessel license and place a moratorium on issuing new licenses. When draft legislation failed to gain sufficient support in Oregon, the moratorium effort lost momentum. Movement toward limiting entry to the groundfish fishery ground to a halt when the Pacific Fishery Management Council voted not to consider a limited entry system for groundfish during its groundfish plan amendment process in 1985.

In 1986 economic conditions in the trawl fishery improved due to a resurgence in the pink shrimp fishery, the reduced number of vessels in the fleet, and the lower capital costs faced by purchasers of distress-sale vessels. Although fishery management agencies are not now considering a limited access program for groundfish, the Council and the Pacific coast states may be faced with making such a decision in the future. Access limitation does afford fishery managers several benefits not achievable with traditional fishery regulations. In the first chapter of this report, nine objectives of limiting access are listed. Among these objectives are economic efficiency, reduced management costs, increased and stabilized fishing fleet profits, equitable distribution of fishery economic benefits, and reduced regulatory burden on the industry. While the reasons for limited access focus on social and economic aspects, it may also contribute to fish stock conservation.

To prepare a thorough examination of alternative approaches to limited access for use in future discussions, a Working Group on Limited Access was formed in November 1984. The Working Group included economists and fishery management personnel from the National Marine Fisheries Service, Pacific Fishery Management Council, and Oregon State University. This report consists mainly of papers written by members of the Working Group for presentation to industry and fishery management agencies concerned with groundfish. The authors of this report drew heavily on papers presented at the Workshop on Management Options for the North Pacific Longline Fisheries sponsored by the Alaska Sea Grant Program, held at Eastsound, Washington, April 1986 (Mollett 1986). A shorter summary report, consisting mainly of the first two chapters of this report and entitled, "A Primer on Limited Access Alternatives for the Pacific Coast Groundfish Fishery", has been printed and distributed by the Pacific Marine Fisheries Commission in Portland.

The Working Group was assisted by an advisory committee called the Groundfish Alternatives Management group (known as "GAM"), organized by Ed Ueber of the Southwest Fisheries Center, National Marine Fisheries Service, NOAA. Included in GAM were representatives from the three coastal state's fishery management agencies and several private industry people. GAM reviewed drafts of this and provided comments and suggestions during three meetings spaced over a 14-month period. Members of GAM are not necessarily in agreement with particular conclusions or views expressed here; nevertheless, their thorough criticism of earlier drafts and their frank and open expression of viewpoints helped immeasurably to improve this report. Also, the "Primer" distributed by PMFC was developed in response to one of GAM's suggestions. We hope that it proves useful to those members of the public who want to become involved in the future direction of fisheries management.

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Introduction: Limited Access, What is it and why?

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Despite its wide acceptance in other fisheries, limited access remains a controversial topic among Pacific coast groundfish fishermen and fishery managers. It is controversial because it immediately opens a wide array of public policy issues. How should the public conserve fish stocks, and who should benefit from harvesting those fish? What are the costs and benefits to the public, the taxpayer, the fishing industry, and the coastal communities supporting the groundfish industry? Should the government push the industry to be economically efficient in harvesting; or should it discourage technical efficiency to conserve fish stocks? Should management preserve the economic status quo by protecting existing harvest shares? These are the broad issues occupying the discussions of policy makers and academic writers concerned with resource management.

The goal of this introductory section is to define limited access, to dispel some basic misunderstandings about limited access, to clarify the optional forms of limited access, and to review the various resource management objectives addressed. This should set the stage for the following more lengthy discussions. By reducing the scope of needless misunderstandings, it should also help to make future discussions of limited access more productive.

WHAT IS LIMITED ACCESS?

Limiting access in commercial fisheries is commonly implemented through either license limitation programs or assignment of quantitative harvest rights. License limitation, most commonly known as "limited entry," is the simplest and most widely used form of limited access in the United States. A license limitation system issues permits to specific individuals (usually fishermen or fishing vessel owners) and prohibits landings by those not having a license. As will be explained at length in later chapters of this report, licenses can be annually renewable or perpetual fishing rights; they may be openly tradeable or strictly assigned to a particular person; they may be specific to a gear type or species of fish. A wide range of conditions and limitations can be placed upon the exercise of the fishing rights bestowed through issuance of a license.

Rather than simply identifying who can fish, quantitative harvest rights designate how much each license-holder can take. Like license limitation, a quantitative harvest rights system can take on a number of different characteristics. A variety of terms have been coined for the various quantitative harvest rights schemes. These include (1) individual fisherman quotas based upon Francis Christy's original proposal in 1973, (2) individual tradeable quotas as recently adopted in New Zealand (Clark and Duncan 1986), (3) quota licenses as proposed by Canada's Commission on Pacific Fisheries Policy (Pearse 1982), and (4) quota shares or allocated vessel quotas (Clark 1980) which represent individual shares of total allowable catch. Throughout most of the discussion we will use the term "individual fisherman quota" (IFQ), recognizing that individual quotas may be allocated to vessel owners or fishing enterprises rather than to fishermen per se. Regardless of what term is used, a quantitative harvest rights system controls the total harvest by distributing harvest shares among participants in the fishery.

To some degree all fishery regulations dictate the conditions under which fishermen are allowed access to fish stocks. Traditional forms of fishery regulations—including harvest quotas with season closures, gear requirements, size limits, and trip limits—restrict access to fish stocks. This is an inherent part of defining terms and conditions for legal resource use. To control annual harvests, these

regulations must reduce the level of fishing effort from what it would be without regulation. Hence, all fishery conservation regulations, both traditional fishery regulations and limited access, conserve fish stocks by controlling the level of fishing effort, and this requires placing limits on use of the stock.

What then is the essential difference between a limited access system and the traditional approach to fishery regulation? The main difference is that traditional regulations seek directly to control harvest levels without saying who should be allowed to take a portion of the total allowable harvest; limited access systems begin by identifying who is permitted to harvest and, optionally, how much they are allowed to harvest. Traditional regulations control aggregate fishing mortality; limited access establishes limits to individual fishing rights.

Limited access will not necessarily supplant all traditional regulations. License limitation, for example, does not directly control the level of harvest by license-holders. Consequently, it may need to be supplemented by fishery-wide quotas and technical restrictions on vessels and gear. Similarly, even though an individual quota system inherently controls total harvest, additional regulations may be needed to achieve optimal utilization of the fish stocks. This is especially true in multi-species, multi-gear fisheries where it is desirable to control size-at-capture, incidental catches, and discards.

Limited access is commonly practiced without government regulation. Common law gives property owners exclusive (but limited) rights to use, to prevent others from using, and to sell property. There are cases of limited access without legal sanction, such as in the famous Maine "lobster fiefs" (Acheson 1975) in which fishing rights to local areas were recognized based upon historic or cultural tradition. Private rights to land, forests, and other forms of property imply limited access and use. The point is that access to the resource for harvesting purposes is limited to some identifiable set of people. Where legally defined rights exist, the owners of these rights may sell, trade and bequeath the rights to others. Because rights can be sold, the identity of resource owners and users may change over time. Access to the resource is limited to those who possess use rights; but the right to acquire ownership is open to all those who wish to obtain use rights by paying the market price or complying with state-imposed qualifications.

All property rights are circumscribed by the law. An owner of urban land must comply with zoning laws. An owner of cattle can continue to feed the animals or slaughter them for market, but he/she must obey law concerning cruel treatment of animals. Ownership in a limited access system permits harvest under specific conditions, but does not permit liquidation of the fish stock. The fish stock in the ocean remains public property managed by the state as a public trust. When licenses and IFQs are marketable, they take on many characteristics of property, including a market price. Nevertheless, fishing rights are use rights, and these are not the same as property rights in the fish stock itself.

WHY CONSIDER LIMITED ACCESS? WHAT'S DIFFERENT ABOUT FISHING?

Commercial fishing differs from farming, small-scale retailing, and other competitive American industries in many respects; the most important is the lack of private property rights in an essential resource. Unlike farmland and mineral deposits, marine fish populations cannot be owned by the users. Historically, in western Europe and North America, property rights to marine fish stocks did not evolve in parallel with rights to land-based resources. Two principal reasons for this are apparent. First, it was not until the rapid expansion in world fishing after World War II that conservation of marine fish stocks was recognized as a serious and widespread problem. So long as people believed in the inexhaustibility of marine fish, there was no widespread desire to develop institutions for limiting access to fisheries. Second, creation and enforcement of rights to marine fish are difficult tasks. Fish are not easily observed and fenced like a plot of land. To establish, enforce, and exchange property rights to fish requires special institutions, legal mechanisms, and ways of doing business.

Today, Pacific coast groundfish stocks are open access or common property resources. With open access resources, there are no restrictions on who can harvest or upon individual harvest levels. An open access resource is literally no one's property (not strictly property at all). In contrast, a common property resource is owned by members of a group or community. Owners have equal use rights. From the standpoint of licensed commercial fishermen, a license limitation system converts a free access resource into a common property resource. Although the licensed fishermen are not legal owners, they become a closed group of resource users, like the animal grazers using a common pasture. With either open access or common property, competitive free enterprise among resource users cannot be expected to assure adequate resource conservation. Additional restrictions on harvests are needed. This need has long been recognized, and it is the reason for public fisheries management.

Harvesters of an open access or common property resource often fail to take appropriate conservation action. It may not be readily apparent to an individual that his use affects the resource size and, ultimately, the profits of all resource users. When there are a myriad of others fishing, a single fisherman will have difficulty even detecting the effect that his own catch has on the overall abundance of fish. Even when fishermen are aware that they affect the size of fish populations, they may take no conservation measures unless they are assured that other users will act in concert to achieve the future benefits of conservation. New entrants may dilute the benefits of conservation when economic returns show improvement.

Thus individual actions, based upon self-interest, cannot assure adequate conservation and cannot effectively promote long-term economic returns from common property or open-access natural resources. Collectively, however, resource users can gain through appropriate restrictions on use. This is true of groundwater basins and public grazing lands as well as fish stocks. Restrictions on individual resource use can be effected through cooperative agreements among users, through certain regional resource agencies like water districts, or even through Federal regulations. In all cases, optimum management requires that individual incentives for short-term economic gain be brought into line with sustainable levels of use.

Regulation of water and grazing lands normally involves quantitative limits to individual use. In medieval England many villages had commons which were regulated through "stinting," a term for

limiting the number of animals grazed by individual peasants. These rules for common property use continue in modified form to modern times. Similarly, sheep and cattle ranchers using public grazing lands in the western United States are allocated so many "animal unit months" (AUMs) which roughly corresponds to a known quantity of forage harvested. Farmers irrigating fields in central California each have a quantity of water to which they are entitled. This entitlement may be attached to the land as a water right. These water and grazing rights are forms of limited access in that they designate both (1) which individuals have use rights and (2) the amount of use allowed.

These forms of limited access are not intended to prevent people from becoming farmers or cattlemen. There is no list of licensed or "qualified" farmers. If you want to try your hand at raising almonds in Kern county, California, you can buy or rent land and obtain the necessary water rights. There is free entry to the industry. Fishing, farming, and retailing are similar in this important respect. To exercise this right of free entry, a business firm must acquire the necessary implements and materials. In farming or ranching one requirement is a source of water or rangeland forage. In an open access fishery, however, a new entrant cannot acquire rights to a given quantity of fish. A newcomer simply dips into the common pool, often taking a portion of the available harvest away from established fishermen.

Rather than establish a limited number of quantitative use rights, groundfish managers have established aggregate harvest quotas (or guidelines) and have instituted other restrictive rules on fishing enterprises in order to achieve economic and social objectives. Individual fishing firms then compete for fish based upon harvesting capacity and skill. When quotas are inappropriate, managers may prefer to restrict effectiveness of the gear (such as maximum allowable length of gill nets) or the portion of the stock that is vulnerable to harvest (mesh size regulations, for example). Pacific coast groundfish regulations incorporate many of these methods. While these harvest regulations may adequately prevent fish stock depletion, they do not address a number of other problems.

Economic and social problems frequently occur in quota-regulated open access fisheries. Some of these problems are:

(1) Economic profits are lost to increased fishing costs. Because individual fishermen can maintain or expand their individual harvest shares only by catching fish at a faster rate, they tend to compete by increasing fishing capacity. This is costly for the individual vessel owner, but may result in increased earnings for the vessel. When the fish stocks are under quotas, increased fishing capacity results in no increased fish catch but does raise the total cost of taking the quota.

(2) Overcrowding and gear conflicts occur. Fishermen concentrate in the best fishing areas and during the best fishing seasons. In some cases this results in a very short and furious fishing season which may pressure individual fishermen to operate under unsafe conditions. This can cause loss of gear and can increase the cost and risk in operating a fishing vessel.

(3) Economic instability due to changing profits and harvest regulations. Excessive numbers of new entrants are often attracted to fisheries during periods of higher-than-normal profits. Many of these new firms will go bankrupt under normal circumstances, leaving the fishing fleet overbuilt and with many small firms in financial trouble. While cyclical instability affects many industries, its impacts are amplified in quota-regulated commercial fisheries. This instability is often further amplified by changing harvest regulations. When new vessels swarm into a fishery during good years, managers will tighten the harvest regulations in response. Unstable regulations make it more difficult for established fishing vessel owners to plan for the longer term.

(4) With large amounts of redundant harvesting capacity, regulatory burdens and management costs become excessive. To assure adequate fish stock conservation, there must be restrictive fishing regulations. Annual quotas may be augmented by trip limits and other restrictions. To implement regulations there must be many committees, hearings, and enforcement agents. The resulting regulatory bureaucracy is costly.

Limited access to commercial fisheries is in part a response to these social and economic issues, but it may be used also as a resource conservation tool in heavily exploited fisheries. Some Australian license limitation programs, for example, were adopted early enough in the developing fishery to prevent extensive overexpansion of fishing capacity. This provides a substantial measure of protection to the fish stocks. A similar degree of conservation could be achieved in heavily exploited fisheries by license limitation followed by fleet reduction, or by IFQs.

OTHER UNCONVENTIONAL APPROACHES TO RESOURCE CONSERVATION

It should be noted that license limitation and IFQs are not the only alternative approaches to common property resource management currently under serious discussion. A radically different approach would be to levy taxes or royalties on fish landings. This sort of approach has been given serious consideration in designing programs to reduce air and water pollution (e.g., the so-called "pollution taxes"), and public interest groups have pushed proposals to increase charges for irrigation water and for use of public grazing lands where those resources appear to be overused or misused. The basic logic of a tax charge is that it changes economic incentives in the correct direction.

Firms using common property resources and firms relying on publicly subsidized resource development projects, do not bear, nor do they adequately take into consideration, the full cost of resource use. This is related to lack of private property rights. The fishing firm does not have a direct financial interest in the economic value of the fish stock; its only interest is in the portion of the stock that it can capture and sell. Consequently, the cost of reducing the fish stock (i.e., reduced catch rates for all firms and reduced future availability of fish) is not felt directly by the firm and it does not consider that cost in deciding how much to harvest. A rancher, on the other hand, must account for the effects of a reduced herd on the book value of his livestock. Similarly, a hypothetical private fish stock owner would bear the cost of a deterioration in his fish stock. The prospect of reduced asset values associated with overfishing would act as a strong incentive to harvest at an economically efficient level. Since firms fishing on a common property stock do not experience the reduced asset value, they do not have the proper incentives to conserve. One solution is for a public agency to compute what that asset deterioration cost should be and establish a royalty fee equal to that cost. After that, the private firms will have the proper disincentives to overfish.

This proposal has been described in textbooks and academic papers, but has never been applied to a fishery. Some reasons for this are apparent. First, fishery managers are most frequently trained in scientific disciplines that do not explore taxation as a means of regulating behavior. Thus the royalty scheme is generally proposed

by an "outsider" and is given less serious consideration than other direct forms of regulation. Second, the political machinery is strongly geared to protecting the rights and financial interests of current resource users. Since the harvest royalty would, at least superficially and in the short run, reduce the income in fishing, it would work to the disadvantage of exactly those resource users who are most clearly represented in the political process. Even though various provisions could be developed to reduce the short-run burden on fishermen and to assure that revenues raised by the royalty were used for resource protection and enhancement, this political aspect raises strong objections to using royalties as a resource management tool.

Other practical reasons for not using landings taxes to manage fish stocks are (1) the computational task is extremely formidable, and (2) the necessary flexibility in tax rate may be difficult to attain in a legislative system. Because the royalty or tax should equal the cost associated with reduced asset value of the fish stock, the tax would have to be adjusted as fish prices, fishing costs, and fish stock abundances change. Given the imprecision in fish stock assessments and the frequency of changes in prices, it is unlikely that the tax rates could be accurately computed and adjusted. Whether the imprecision in tax rates would create more difficulties than, say, imprecision in harvest quotas is a topic for future research and discussion.

Also, authority to set tax and royalty rates is not now delegated to state fish and game agencies or to the Pacific Fishery Management Council. Thus the legislatures would have to change tax rates in a timely and appropriate fashion, or they would have to delegate such power to managing agencies or commissions. It might be possible to develop legislation that would allow agencies to vary royalty rates based upon economic and biological criteria. Because this sort of system has had little political support, it has not been thoroughly examined. Further work may reveal promising alternatives for tax or royalty management, but this will require longer term research and development than license and IFQ options.

OBJECTIVES OF LIMITED ACCESS

Limiting access to commercial fisheries can address a great number of different objectives. Some of the more prominent objectives are as follows:

1. Promote economic efficiency in harvesting.
2. Establish stable and secure tenure to the fishery for licensed fishermen.
3. Enhance the value of fishery products delivered to consumers.
4. Increase and stabilize the profitability of the fishing fleet.
5. Reduce the burden of management regulations on the industry.
6. Reduce the cost of fisheries management born by the public.
7. Secure an equitable distribution of benefits from the fishery.
8. Protect various segments of the fishing industry from other fishermen and non-commercial interests.
9. Help restrain fishing effort and conserve fish stocks.

This list does not include every conceivable objective, but it does illustrate the broad range of considerations that can be addressed. A brief explanation of these objectives will help to focus the discussion.

Economic efficiency in harvesting involves delivering the available raw fish to dockside with the least possible cost expended on fishing, and delivering the fish in appropriate condition and on a time schedule suitable for marketing. Because open access fisheries normally exhibit substantial excess fishing capacity, which is controlled by quotas and other economically inefficient regulations, substantial advances may be made toward this goal through limited access. To actually calculate an efficient harvest program is a difficult task that is rarely attempted. It was recently estimated that an efficiently operated Pacific coast groundfish fishery could generate between $7 million and $17 million annually in net economic benefits. This could be accomplished with a fishing fleet approximately 40% smaller than the fleet operated in 1984. Where the total falls in this range depends mainly on the size of the Pacific whiting fishery. (See Chapter 5 for details.) A new limited access system may not be able to achieve the estimated level of economic gains, at least not without a moderately long adjustment period, but the potential gains are sufficient to make increased economic efficiency an important objective.

Secure tenure in the fishery has at least two dimensions. It means that a fisherman does not have to perform up to a particular state-imposed standard in order to continue in the fishery, and it means that a fisherman is assured of future benefits from sacrifices made to conserve fish stocks. In open access fisheries, and in some license limited fisheries, a fisherman cannot reduce his fishing or stop fishing temporarily in hopes of harvesting larger or more numerous fish later. With secure, individual fishing rights, however, a fisherman can afford to fish more slowly and to wait until fish are of optimal size or in optimum condition.

The quality of fish delivered to market may be improved under a limited access system. Fishermen and processors operating under open access are sometimes forced to compete for fish by harvesting in a hurry. This may result in increased occurrence of spoiled or unnecessarily frozen fish products. This is especially a problem when traditional quota management results in short fishing seasons that overwhelm the processing and distribution sectors. If fishermen are given individual quotas, they are free to stretch out the fishing over a longer period of time. Recent Pacific halibut experience provides the classic example of open-access fishing causing so short and furious a fishing season that costs of processing and storing the high-valued product are higher than necessary, and almost all the fish have to be frozen.

Profits are usually highest when fishing fleets begin exploiting a new fish stock or have a particularly large year-class of traditional fish stocks. The usual tendency, however, is for profits to fall as additional vessels are attracted. If the fleet size grows as the fish stock is depleted, then a period of serious economic dislocation may ensue. Recent experience with rockfish stocks off the Pacific coast provides a case study in this process. A properly managed limited access system would be able to prevent the instability in profits by attenuating the growth and decline in the fishing fleet. Higher fleet profits can be earned when the numbers of fishing vessels are just sufficient to harvest the available yield. Sustained high profits require stability in market prices, costs, and fish stocks. Limited access cannot provide stability in all these, but it does remove one common source of economic instability and should result in higher average annual profits.

Reducing the burden of fishing regulations on the industry is an appropriate goal, but it is unclear what particular change in regulations constitutes a reduced burden. Regulations on gear quantity or design, commercial fishing seasons, and "trip limits" may be viewed as a burden. From an economics perspective, all these forms of regulation cause private fishing operators to incur additional costs. By establishing a reduced and more efficient fishing fleet, limited

access may permit some of the regulations to be removed. Whether such a change would result in an overall reduction in burden of regulations is largely a matter of definition and perception.

Reducing the public expenditures on management would relieve the taxpayer's burden of fishery regulations. The current groundfish management system uses public resources to perform necessary biological research and fish stock assessments, to monitor fish landings, to support Coast Guard and State marine enforcement operations, to carry out legal sanctions against violators of regulations, and to make public decisions on management plans. A recent rough estimate of costs associated with Pacific coast groundfish indicates that about $5.5 million is spent on resource assessment, and $5.6 million on management, enforcement, coordination, and communications. (See Chapter 6 for details.) Costs of managing a fishery will, of course, depend partly upon the character of the fishery and partly upon the types of regulations promulgated. If limited access is conducive to lower management costs, this should be an important consideration.

Everyone agrees that fishing regulations should entail an "equitable" distribution of benefits. Although there is no widely recognized definition of equity, there are clear patterns in management practice. In a recent study of twelve government programs that allocate property rights, Rolph (1983) found that policymakers deal with the equity issue by designing regulations to minimize any redistribution of wealth. Where established resource users enjoy benefits of a communal resource (such as in land development, air pollution, groundwater pumping) "the judicial, the legislative, and the executive branches have uniformly supported the claims of historic users when allocating rights." This principle seems to be honored as well by the existing fishery limited-access system. A reasonable way of dealing with the equity question, therefore, may be to assure that no established fishermen suffer a measurable loss due to the access regulations. As a first approximation this can be accomplished by retaining historic allocations of catch among existing gear types, vessel size classes, and geographic subdivisions. Where rapid changes have been occurring in the fishery, it is not clear that historic shares preserve the economic status quo. New entrants and previous operators with new vessels may pose a problem, for example. Nevertheless, initial preservation of historic catch shares under a limited access system provides a simple and operational means of dealing with the equity effect of the new system.

To protect various segments of the fishery from one another may be more than just another form of the equity issue. Where recreational or environmental interests collide with commercial fishing interests, a limit to commercial fleet size may help to quell strong political and economic forces that could eliminate the fishery entirely. California has adopted license limitation programs in the drift gill net swordfish and shark fishery and in the northern California set gill and trammel net fishery in order to deal with politically potent rivalries between user groups. Limited access has proved to be a useful tool for staking out territories and limiting the range of conflict.

Finally, limited entry can assist in conserving fish stocks. In the case of license limitation, the control over fishing effort may be too weak and ineffectual to assure fish stock conservation. On the other hand, an individual quota system provides direct controls over total harvests and may be a useful substitute for other forms of effort regulation.

No single system of regulation could address all nine of these objectives simultaneously and with equal success. A limited access system must be tailored to the specific objectives sought. And it must address the various private and public interests reflected in the objectives discussed here.

CONCLUSIONS

Several conclusions from the preceding discussion are worth repeating and summarizing. First, a limited access system is basically a social mechanism for reducing the excessive competition for fish that occurs when fish stocks are open to all comers. It is an alternative or a complement to traditional quota, season, and gear regulations. Among the alternative regulatory systems, it is uniquely able to address economic efficiency of the commercial fishing industry. In fisheries that are already highly regulated like Pacific groundfish, limited entry should be viewed as one component of a multidimensional management strategy. The choice is not between limiting access to the fishery or having a free and open commercial fishery. Rather it is between one set of regulations on competitive fishing and another set.

Second, there are several varieties of limited access. The two alternatives receiving the most attention are license limitation and IFQs. With either major type of limited access there are numerous variations in detailed application. Much public discussion and participation should be devoted to determining exactly what features to include in a limited access program for any particular fishery. The ultimate allocation of benefits from the fishery would depend upon the detailed decisions made in designing an actual limited access program.

Third, the problems of economic competition for common property or open access resources are not unique to fisheries; adoption of limited access rules are implicit in many other economic systems, including that of private property resource ownership. Rules for use of rangeland, groundwater supplies, and the air have similar features to fishery regulations. While the elusive marine fish populations are not susceptible to subdivision into pieces of private property, the limited access approach attempts to generate some of the conservation and economic benefits that flow from a free enterprise, private property system.

Finally, it is clear that selection of management method determines what fishing rights or privileges, with corresponding economic benefits, are enjoyed by commercial users of the fishery resource. When a season closure or a license limitation is adopted by the fishery management authorities, the fisherman's economic gain from fishing is altered. Thus the nature of fishing rights or privileges is subject to change at the discretion of fishery councils. Commercial fishing rights are not "inalienable rights" like the right to free speech. They are even less secure from political meddling than standard property rights applying to one's personal possessions. To the extent that a limited access system does establish broader and more secure fishing rights, it will place the fisherman in a position much closer to that of a property owner. But the key decisions will remain those of the public managers whose trust responsibility is established by the various state and federal laws.

2

Profile of the Groundfish Fishery

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The groundfish fishery off California, Oregon, and Washington is a highly diverse fishery. Several different commercial vessel and gear types harvest a large number of species in all sections of the coast. Recreational hook-and-line fishing is important as well, especially in central and southern California. Figure 1 illustrates the International North Pacific Fishery Commission (INPFC) areas for which commercial fishing data and management regulations are reported.

Species classified as "groundfish" include flatfishes (e.g., Dover, English, petrale, rock, and rex sole), roundfishes (e.g., sablefish, Pacific cod, ling cod, and Pacific whiting), a large number of the *Sebastes* species (yellowtail, canary, widow, boccacio, chilipepper, and shortbelly rockfish), and thornyheads (*Sebastolobus*). The Pacific Coast Groundfish Fishery Management Plan also includes certain sharks, skates, ratfish, rattails, jack mackerel, and other fish that are of minor importance to the fishery.

Commercial groundfish fishing is divided into three distinct segments: shoreside domestic landings, "joint venture" harvest, and foreign catch. The quantity and exvessel value of shoreside landings (Table 1) grew from about 60 thousand metric tons (mt) and $20 million in 1976, to 120 thousand mt and $60 million in 1982. As the rockfish harvest declined, however, the totals fell to about 90 thousand mt and $49 million in 1984, although the exvessel value recovered to $57 million in 1985. As shown in Table 2, most of the commercial stocks of groundfish have been harvested at or near the maximum sustainable levels estimated by the Groundfish Management Team. Unless the domestic fishery expands its harvest of less utilized fish stocks (such as shortbelly rockfish and Pacific whiting), the total harvest is unlikely to grow by more than a few thousand tons.

Since 1978, "joint venture" agreements between domestic trawl fishermen and foreign floating processors have become an important factor in the harvest of Pacific whiting. This provides a major source of income for many of the new, midwater trawl vessels. Annual harvests in joint venture fishing grew to 79 thousand mt in 1984, but fell back to 31 thousand mt in 1985. Since this is still far below the estimated sustainable yield of 175,000 mt, expansion of both joint venture and shoreside landings is possible.

Foreign harvests declined substantially after 1976. With the expulsion of Soviet and Polish trawlers after Soviet invasion of Afghanistan, foreign harvest stopped entirely. In 1985 Polish vessels were again permitted to harvest Pacific whiting. Foreign harvest of underutilized species can continue under Governing International Fishery Agreements negotiated with the State Department until the U.S. fishing industry demonstrates a capacity and intent to take the entire available biological yield.

Tables 3a and 3b show the breakdown of harvests of the most important species groups in 1985 by geographic areas and gear types. Rockfish seem to concentrate mainly in the Columbia area and the Monterey area, while sablefish catch is more evenly distributed along the coast. The Columbia area is most important and the Conception area is least significant for all main species groups. The huge volumes of Pacific whiting caught in Vancouver and Columbia areas are due to the joint venture fishery. From Table 3b it is clear that trawl fishing dominates to an overwhelming degree the commercial harvest of groundfish. Fixed gear (pots and traps, gill nets, and hook-and-line) took a substantial portion of the sablefish in 1985 and a moderate amount of rockfish and other groundfish. The division of catch among the gear types will exhibit some variation over the years, but trawl gear always dominates.

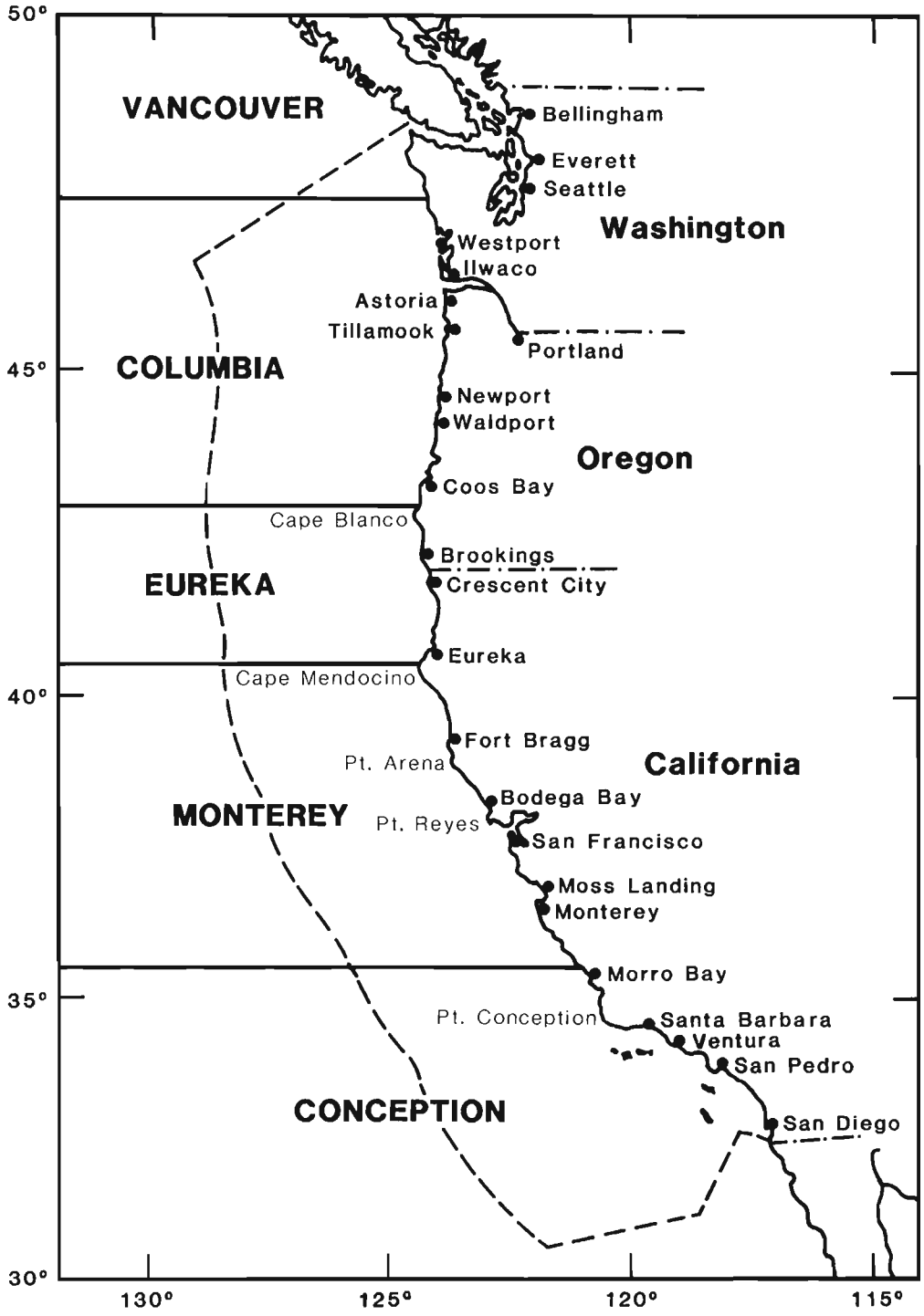

Figure 1—Pacific coast region with INPFC statistical areas, major fishing ports, and exclusive economic zones.

Table 1—Pacific coast groundfish harvest quantity and exvessel values. n.d. = no data.

	Domestic harvests					
	Shoreside		Joint venture		Foreign[1]	
Year	1,000 mt	$mil.	1,000 mt	$mil.	1,000 mt	$mil.
1976	57.0	19.4	—	—	255.0	n.d.
1977	59.8	20.7	—	—	118.0	n.d.
1978	71.6	34.5	0.9	0.1	98 0	13.3
1979	90.0	47.9	8.8	1.2	117.0	15.9
1980	87.9	37.1	26.8	3.3	44.6	5.5
1981	103.9	46.8	43.8	6.3	70.9	10.2
1982	119.0	60.0	67.7	10.4	7.3	1.1
1983	97.7	52.2	72.1	10.2	—	—
1984	89.6	49.1	79.0	11.8	14.8	2.2
1985	89.8	57.0	31.6	3.8	50.2	6.1

[1]Foreign fishery value calculated on assumption that price is equal to joint venture average price per metric ton.

Sources: Pacific Fishery Management Council (1982, 1986).

Table 2—Pacific coast groundfish harvests, estimated maximum sustainable yields (MSY), and allowable biological catch (ABC). n.d. = no data; * = MSY estimated to be at least as large as ABC.

	Annual harvest				
Species	1976	1982	1985	MSY	ABC 1986
Arrowtooth flounder	n.d.	n.d.	2,568	—	—
Dover sole	13,179	20,916	20,525	24,398	27,900
English sole	4,488	2,771	1,871	4,500	1,500
Petrale sole	2,816	2,619	1,826	3,200	3,200
Other flatfish	4,690	11,691	3,455	*	7,700
Boccacio	n.d.	n.d.	1,250	6,100	6,100
Canary rockfish	n.d.	4,296	2,046	3,500	3,500
Chilipepper	n.d.	n.d.	1,001	2,300	2,300
Yellowtail rockfish	n.d.	8,715	3,058	3,416	4,855
Pacific Ocean perch	2,336	893	1,375	5,300	1,550
Shortbelly rockfish	—	3	12	44,200	10,000
Widow rockfish	—	25.445	9,026	9,200	9,300
Remaining rockfish	n.d.	n.d.	15,225	*	13,700
Thornyheads	n.d.	n.d.	4,067	4,400	4,400
Ling cod	2,542	3,809	3,809	7.000	7,000
Pacific cod	2,165	910	377	*	3,100
Pacific whiting					
Shoreside	trace	1,023	3,895		
"Joint Venture"	0	67,465	31,512	175,500	300,000
Foreign catch	231,000	7,089	50,563		
Sablefish	7,028	18,592	14,580	7,200	10,000
Other roundfish	5,187	4,918	5,723	*	14,700
Totals	295,482	193,550	170,146	339,414	430,805

Sources: 1976 harvests from Pac. Fish. Manage. Counc. (1982), Table 8. 1982 and 1985 harvests from PACFIN Rep. 001.
MSY estimates and ABCs from Pac. Fish. Manage. Counc. (1985).

Table 3a—1985 Pacific coast commercial domestic harvests (mt) by INPFC area and species group.

Species group	Vancouver	Columbia	Eureka	Monterey	Conception	Total
Rockfish	3,406	14,684	6,024	9,751	2,892	36,800
Sablefish	5,745	5,307	2,480	3,214	269	14,016
Pacific whiting	14	885	2,996	—	—	3,895
Other roundfish	2,253	2,340	(	6,902	)	11,495
Flatfish	4,306	9,262	7,203	7,619	1,847	30,237
Others	123	45	97	113	101	479
Total	14,819	30,424	(	51,679	)	96,922

Source: PACFIN Rep. 001. Includes joint venture catch.

Table 3b—1985 Pacific coast commercial groundfish harvests (mt) by gear type and species group.

Species group	Groundfish trawls	Pots and traps	Shrimp trawl	Gill nets	Hook-and line	Other
Rockfish	29,692	56	372	2,996	1,764	1,915
Sablefish	7,194	3,574	34	231	2,665	343
Pacific whiting	3,886	—	7	1	—	1
Other roundfish	14,300	4	—	416	208	418
Flatfish	30,016	1	54	54	57	57
Others	289	—	1	116	39	34
Total	85,377	3,635	468	3,814	4,733	2,768

Source: PACFIN Rep. 009.

Coinciding with the growth in groundfish harvest was an expansion in commercial fishing fleet size (see Table 4). The greatest increase in fishing capacity is due to additional trawl fishing vessels. The number of active Pacific coast trawlers grew from about 270 in 1976 to 444 in 1982. Recent financial difficulties (which coincided with decreased rockfish harvests and some lower groundfish exvessel prices) have caused the trawl fleet to shrink by about 87 vessels. During the same period of nine years, the number of vessels fishing with fish pots or traps grew from 36 to 207 and then fell back to 34. This pattern of growth and decline was widely attributed to the changing Japanese demand for sablefish, the major target species for fish pots.

Longline (or setline) fishing vessels target mainly on sablefish and rockfish, although they take significant amounts of ling cod as well. Some Pacific halibut is taken by longline off the Pacific coast, but in comparison with the Gulf of Alaska fishery this is a relatively insignificant fishery. The number of hook-and-line fishing vessels has remained in the neighborhood of 200 in recent years.

Set net fishing (including gill nets and trammel nets) for groundfish species has expanded in two areas. In central and southern California (i.e., the Monterey and Conception statistical areas) there were nearly 900 licensed gill net fishermen in 1984. Gill net harvest grew from about 1,460 mt in 1981 to 3,814 mt in 1985. California groundfish set gill and trammel nets catch mainly rockfish, ling cod, California halibut, and croakers. The number of commercial set net fishermen is limited by a State license limitation program. The second area of gill net expansion is the Washington coast, where the success of one experimental gill net fisherman in 1980 has led to the entry of a dozen additional commercial set net operators. Operating at depths ranging down to 200 fathoms in canyons, the

Table 4—Groundfish fleet size, 1976-84.

Year	No. vessels with specified gear		
	Otter trawl[1]	Pot/trap[2]	Longline[2]
1976	269	36	N/A
1977	286	60	N/A
1978	351	119	N/A
1979	472	207	299
1980	458	116	205
1981	408	66	191
1982	444	82	208
1983	436	61	184
1984	398	34	[3]96
1985	357	32	[3]129

Source: Korson and Silverthorne (1985).

[1]Vessel numbers before 1981 include double-counting of vessels fishing in more than one state.

[2]Vessels landing fish with these gear types in two or more states are counted more than once.

[3]These numbers represent only Oregon and Washington with double-counting eliminated. California data not available at time of publication.

Table 5—Catch and revenue share distributions among 401 active groundfish trawl vessels, 1983 and 1984.

Top % of vessels	% of groundfish catch		% of revenue	
	1983	1984	1983	1984
10	35.6	32.9	32.6	30.4
20	57.0	53.7	53.3	50.8
30	71.6	69.1	67.6	65.7
40	82.0	80.8	78.5	77.4
50	89.1	88.5	86.4	85.8
60	93.9	93.8	92.1	92.0
70	96.9	97.0	95.9	95.9
80	98.9	98.9	98.5	98.4
90	99.8	99.8	99.7	99.7

Source: Annual summary records for vessels using bottom, groundfish, or midwater trawl gear. Includes domestic landings and exvessel revenue from all species landed by trawl vessels.

Table 6—Technical changes affecting fishing power and safety characteristics of Pacific coast trawlers.

Technical innovation	% adopting		
	Before 1980	1980-84	Total
Midwater trawling	3.7	18.1	21.7
Chromoscope	1.2	43.4	44.6
Sonar	21.7	19.3	41.0
Track plotter	13.3	48.1	61.4
Radio facsimile	3.6	7.2	10.8
Survival suit	48.2	32.5	80.7
EPIRB	8.4	16.9	25.3
Personal computer	4.8	6.0	10.8

Source: Dewees (1985).

set nets catch primarily sablefish, "slope" rockfish, arrowtooth flounder, and spiny dogfish.

Pacific coast groundfish fishermen often take nongroundfish species as well. In 1981, for example, 152 of the 340 coastwide shrimp trawlers switched to groundfish trawl gear for at least part of the year. Due to poor shrimp yields in 1982 through 1984, nearly all of the pink shrimp trawlers converted to groundfish trawling. This is one source of new entrants to the groundfish trawl fleet. Ability to shift among target fisheries is also exhibited by smaller inshore trawlers of the Crescent City area which fish for Dungeness crab in the winter and trawl for sole and rockfish during the fall and spring.

Groundfish vessels display a significant amount of geographic mobility as well. It is not uncommon for midwater trawl vessels to fish in joint venture operations off the West coast or in Alaska during the spring and summer, but to fish rockfish for shoreside processors during the winter. Nearshore, flatfish trawlers are known to make seasonal shifts between ports as distant as Crescent City and Morro Bay, California. Similarly, large groundfish processors are not reluctant to purchase raw fish from geographically dispersed sources. A Eureka area processor, for example, may buy fish in Coos Bay and San Francisco when it is convenient to do so.

Both economic reasoning (see Huppert 1979) and statements by industry members suggest that the degree of flexibility reflected in the geographic, gear, and species switching in the commercial fleet is an important aspect of business strategy. When market prices and species availability exhibit unanticipated fluctuations, commercial operators with experience and expertise in several different fisheries have an advantage. They can respond by shifting among fishing activities which will reduce their business risk by "diversification," in much the same way that investors diversify among stocks, bonds, and other assets. Many trawl fishermen consider it essential that management regulations allow them to move between joint venture fisheries (either Pacific coast or Alaska) and shoreside domestic fishing, between bottom trawling and midwater trawling, and between shrimp and bottom trawling. This multipurpose capability must be recognized in designing a limited access system.

Another fleet characteristic important to the operation of a limited entry system, the concentration of harvests among a small proportion of vessels, is displayed in Table 5. To construct this table we ranked domestic trawl vessels in order of annual tonnage landed and exvessel value of shoreside landings in 1981 and 1982 (not including joint venture catch). The top 10% of the fleet caught 43% of total fleet landings in 1981 and 44% in 1982. Ninety percent of the total catch was taken by only 50% of the nominal trawl fleet. Exvessel value of landings is not quite so concentrated in the upper end of the fleet, indicating that higher volume of landings is associated with lower value per ton landed. We expect that concentration of volume and value of landings would be about the same in recent years.

The technical capabilities of commercial fishing vessels are being steadily improved. Dewees (1985) has recently studied the rate of adoption of technological innovations by the trawl fleet. Table 6 summarizes some of Dewees' findings based upon interviews with 83 trawl vessel operators during 1984. Of the eight technical innovations examined, the four that seem to contribute most directly to fishing power are midwater trawling, chromoscope, sonar, and track plotter. The radio facsimile, survival suit, emergency position indicator radio beacon (EPIRB), and personal computer are

Table 7—Length distribution (ft) of trawl vessels in 1984, and disposition of 100 vessels missing from the active fleet in 1984.

	<30	30-39	40-49	50-59	60-69	70-79	80-89	>90
1984 fleet	2	20	100	108	105	44	11	8
Known losses	1	5	25	27	26	11	3	2
Sunk	0	1	8	12	10	6	1	2
Alaska and other	0	0	0	3	5	3	3	4
Repossessed	0	1	4	1	5	5	2	1
Inactive	0	1	2	4	1	0	0	0
Other	0	0	2	4	4	0	1	0

Note: A total of 201 trawlers that landed groundfish on the Pacific coast during 1981-83 did not land fish during 1984. Of these we have information on the disposition of 103. For three of these we do not know the vessel length, and they are not reported in the table.

more closely related to safety and convenience. While the specific contribution of any of these innovations to fish harvest capability or safety would be difficult to quantify, the fact that new equipment is rapidly adopted by a significant portion of the fishing fleet indicates that fishing capacity is changing and expanding in many dimensions. This suggests that it would be a mistake to rely heavily upon the number and size of vessels as a simple measure of fleet capacity.

Due to both the changing technology and the wide variation in landings among vessels, one cannot assume the fleet's harvest will be proportional to number of active vessels. Consequently, a license limitation program coupled with attrition or voluntary "buy-back" of licenses may have surprisingly little effect on fleet capacity. Even if "high-liners" are targeted in the fleet reduction, it is possible for licensed vessels that were previously low producers to become high-liners.

During 1983 and 1984 the trawl fleet was beset by falling rockfish quotas, falling sablefish and Dover sole prices, and a backlog of high interest-rate loans. One result was an unusual number of losses from the fleet due to bankruptcy, bank repossessions, sinkings, and transfers to other fisheries. Of the 599 trawlers known to have made commercial sales of groundfish during 1981-84, a total of 201 were no longer in the Pacific coast fishery in 1985. We were unable to ascertain the fate of all 201 vessels, but information on 100 vessels has been summarized in Table 7. This shows that losses from the fleet occurred among almost all sizes of vessels and that there was no disproportionate loss from large or small size categories. Forty-five percent of the known losses were due to sinkings or burnings, 21% percent were repossessed and inactive, 20% of the vessels were fishing in Alaska, 8% were fishing in other fisheries, and 6% were still afloat but not fishing.

The financial hardships reflected in these losses from the trawl fleet had a variety of causes, and have elicited a variety of suggested solutions, including a return to use of mesh size restrictions rather than species quotas; elimination of trips limits on rockfish; greater involvement of industry representatives in management decisions; grouping of species quotas to reflect catch groupings; leaving regulations unchanged for longer periods of time; prohibition of discards; prohibition of gill nets; better stock assessments by biologists; creation of a separate California regional fishery management council; reduced dependence of management on fishery data (i.e., fish tickets and logbook records); and placement of a moratorium on trawl vessel licenses. All of these suggestions (and many others not listed here) have been delivered in person or in writing to the Pacific Fishery Management Council and its subgroups. Many deserve serious attention by the management agencies. However, financial and management problems prompting the trawl license moratorium proposal and some of the other more controversial proposals seem to have declined since 1984. This may provide a needed respite for careful and thorough consideration of a range of new management alternatives, including license limitation systems and individual fishermen quotas.

CONCLUSIONS

Based on this short review of the groundfish fishery, several important implications for discussion of limited access are evident. First, both the total levels of harvest and the trawl fleet size seem to have peaked in 1982. Future growth of the fishery will depend upon increased exploitation of less valued stocks such as Pacific whiting and shortbelly rockfish. There seems to be more than sufficient fishing capacity for the traditional species. Second, geographical and biological diversity of the fishery resources results in a wide variety of fishing operations. Although trawl vessels dominate the catch, the pot, longline, and set net fleets harvest substantial amounts of fish as well. Third, flexibility in fishing patterns by the predominant trawl fleet suggests that a harvest rights system requiring fishermen to specialize in predetermined areas, species, or gear might be too restrictive for economical fishing operations. Finally, the concentration of harvests in a small portion of the fleet, and the pace of change in fishing technology, indicates that simple controls on fleet size cannot be expected to wield much control over fishing capacity or harvest levels.

3

Elements of a Limited Access Program

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This section presents the basic "nuts and bolts" of limited access, carrying the discussion of limited entry beyond the general considerations reviewed in previous sections to look at specific elements. A proposed checklist of items for consideration, along with a brief description of the main options is presented in Figure 1 below. Seven basic decision categories are:

(1) Scope of the fishing activity to be restricted or allocated
(2) Method of limiting access
(3) Initial allocation of harvest rights
(4) Transferability of harvest rights
(5) Longevity of harvest rights
(6) Mechanisms for adjusting the number of harvest rights
(7) Handling disputes regarding issuance and transfer of rights.

In the absence of limited access to the fishery, any U.S. resident who pays the appropriate fees to State authorities has a right to fish for groundfish. This right is circumscribed by the various restrictions on commercial gear (e.g., trawl net minimum mesh size), by fishing season closures, by "trip limits," by incidental catch allowances, and prohibitions on retaining salmon and halibut. There is no legal restriction, however, on who can participate at any given time or place, and no specific restriction on the amount that any individual can legally land during a given fishing season. Thus, while there are many restrictions on fishing practices, current fishing rights are unlimited in number, unrestricted in total harvest amounts, and very inexpensive for the individual to maintain.

The discussion of elements in Figure 1 will focus on a trawl license limitation proposal developed in November 1984 by the Fisherman's Marketing Association and Coast Draggers Association (FMA/CDA) (see Appendix A). Although that proposal is called a moratorium, it has the essential features of a license limitation program. Of interest here is the contrast between the features outlined in that specific proposal and the alternatives listed in Figure 1. We will proceed through each of the seven categories.

SCOPE

The FMA/CDA proposal envisions a relatively narrow scope for the license limitation program in some respects (limited to trawl vessels) and a rather broad scope in other respects (covers entire coast and all species of groundfish listed in the management plan (Pac. Fish. Manage. Counc. 1982)). It leaves out all other commercial gear types and recreational fishing. Except in southern California, the recreational component of groundfish catch is too small (and will probably remain too small) for this exemption to matter much. Ignoring other gear types, however, is a more substantive deletion. Although trawl gear dominates the total catch, gillnet fishing is apparently on the rise and may portend greater competition for fish and space in the future. One strength of this approach is that it limits the most important element of the commercial fleet while minimizing the number of individual fishing operations that must be regulated.

By including all groundfish species and all fishing sites on the west coast, the FMA/CDA proposal would preserve great latitude in trawl fishing operations. Trawl vessel operators have suggested that they need to have many options open to them under any regulatory system. Geographic area and fish species availability are two dimensions to these "options," but there are others. For example, with a large fishing fleet and great latitude in fishing

Figure 1—Limited Access Program Elements and Options

I. **Scope of fishing activities to be restricted or allocated**

- A. Types of fishing to be included
  1. All commercial and recreational
  2. All commercial plus for-profit party and charter boat fishing
  3. All commercial fishing
  4. Only "big-time" commercial operations, such as those landing at least 50 tons of groundfish per year.
- B. Geographical extent
  1. All Pacific coast including at-sea sales
  2. All Pacific coast shoreside landings
  3. Pacific coast shoreside harvests from the 3-200 nautical mile zone (FCZ, excluding state waters).
  4. Harvests in certain selected INPFC areas such as the Vancouver or Columbia areas.
- C. Fishing gear types
  1. All gear including groundfish trawl, hook and line, fish pots, gill nets, and shrimp trawls.
  2. Control only "directed" fishing with trawl gear, fish pots, and gill nets.
  3. Control only the major gear type—trawls (see FMA Proposal Appendix A).
- D. Species of fish
  1. All species listed in groundfish fishery management plan (Pac. Fish. Manage. Counc. 1982).
  2. Include only "important" groundfish species (e.g., all rockfishes, whiting, sablefish, Dover sole, English sole, petrale sole, Pacific cod, ling cod).
  3. Focus harvest permits or rights on single species or logical groups of species. For example, a "rockfish" permit or a "whiting" joint venture permit.

II. **Means of limiting access to the fishery**

- A. License limitation
  1. Personal License to fish (with or without limiting to "natural persons").
  2. License attached to vessel
  3. License attached to gear (e.g., net)
  4. Dual system: fishing license for people plus vessel or gear permits.
- B. Individual fisherman quota (IFQ)
  1. IFQ conveys right to take a share of the allowable yield of specific stocks.
  2. IFQ conveys right to take annually a specified quantity from a specific stock.
  3. Annual yield is assigned to a company or fisherman's cooperative to be subdivided among fishermen. ("Enterprise quotas")
- C. Taxes, royalties and fees
  1. Set initial entry fees high enough to discourage excessive participation.
  2. Establish landings royalties for fully utilized species.
  3. Establish annual license renewal fees.

III. **Basis for initial allocation of harvest rights**

- A. Administrative assignments
  1. Include all persons or firms with recent record of landings (e.g., landed at least one fish in the past five years).
  2. Include all applicants within a specified time period.
  3. Include all persons or firms meeting minimum landings requirements.
  4. Hold a lottery among all applicants.
  5. Include all persons meeting certain qualifications as commercial fishermen.
- B. Competitive market allocation
  1. Auction off limited number of fishing licenses or IFQs.
  2. Sell licenses or IFQs at prices calculated to reflect market values.

IV. **Transferability**

- A. Nontransferable
  1. Retirement or death causes termination of fishing license or harvest right; may revert to State to be reissued.
  2. Ownership transfer not allowed, but owner may lease or lend fishing right.
- B. License or IFQ attached to specific vessel or gear
  1. Transfer requires sale of vessel or gear.
  2. May be transferred among vessels of equal fishing capacity.
  3. May be subject to clearance by State and qualification of new owner.
- C. Fully transferable at discretion of owner
  1. Market sales may be subject to clearance by State fisheries agency or review board.
  2. State may require that new vessel have no more harvest capacity than previously licensed vessel.

V. **Duration of term of fishing right**

1. Perpetual. The license or IFQ can be used as long as the owner wishes.
2. Annual, renewable or nonrenewable. Renewal could be automatic or could depend upon continued participation in fishery.
3. Dependent upon lifetime or career of permit holder. License or right expires upon death or retirement of holder.
4. Fixed, multiyear term. License or IFQ might confer right to fish for, say, 10 years.

VI. **Means of altering number of licenses or fishing rights**

- A. Fleet reduction
  1. Attrition through retirement, termination, revocation for cause.
  2. Buy-back of perpetual or long-lived licenses by State or Federal agency.
  3. Automatic expiration of fixed-term licenses in conjunction with issue or sale of reduced number of new licenses.
- B. Increase in number licenses or rights
  1. Lottery among "qualified applicants".
  2. Sale to applicants at agency-established price.
  3. Selection of new licensees on first-come, first-served basis.
  4. Auction of new licenses or rights in competitive market open to all.

VII. **Settling disputes regarding issuance and transfer of fishing rights**

- A. State/Federal Court
  Fishermen can ultimately seek redress in the courts under any of the options.
- B. Administrative Law Judge (ALJ)
  1. ALJ could make a final administrative ruling after hearing with fisherman.
  2. ALJ could make recommendation to agency administrator after hearing issue.
- C. Special Appeals or Review Board
  1. A board of peers (industry representatives) could make rulings or recommendations to agency administrator.
  2. A board of disinterested citizens could hear disputes.
- D. Agency Administrator
  1. Administrator could make final rulings for agency (e.g., NMFS Regional Director).
  2. Administrator could be bound to pass issue to Federal department head.

options, current fish stock conservation regulations have limited the ability of trawl vessels to choose timing and quantity of rockfish to catch by imposing trip limits and season closures.

Three alternatives to the FMA/CDA proposal meriting consideration are (1) including all gear types in the license limitation program, (2) limiting the scope to "major" groundfish species, and (3) permitting small catch levels by unlicensed vessels. Extension to all gear types would increase the size of the licensed fleet by an order of magnitude, but would bring the various fixed gear vessels under control early. This would address the potential future problem of expanding harvest capacity by an unregulated portion of the fishing fleet. Second, the idea of licensing only those vessels fishing "major" species would alleviate the need to include in the limited fleet every vessel that catches an occasional spiny dogfish or soupfin shark. Without restricting the program to major species, the extension to all gear types would undoubtedly make the system too all-inclusive and cumbersome.

A third option might be to allow unlicensed vessels to land groundfish below a certain limit. All unlicensed vessels could be allowed, for example, to land up to 1,000 pounds of groundfish on any trip, or up to 10,000 pounds per year. This would permit the minor incidental catch of groundfish by trollers, shrimp vessels, and purse seiners without adding these vessels (and the redundant harvest capacity they might represent) to a permanent licensed groundfish fleet.

MEANS OF LIMITING ACCESS

The FMA/CDA proposal is for a groundfish fishing license attached to the vessel. The principal alternative form of licensing, the personal fishing license, has been adopted in Alaska and elsewhere. The choice between these two license alternatives should have some effect on relative bargaining strengths of vessel owners and fishermen. With personal licenses limiting the number of people who can legally fish, ownership of capital equipment is not a prerequisite for ownership of fishing rights. In the Alaska salmon case, personal fishing licenses cannot be used as collateral for loans and cannot be owned by corporations. These provisions were supposed to protect licensed fishermen from some possible threats to their continued participation in the fishery. Vessel owners might object to this because their ability to continue receiving income from a capital investment would depend upon success in recruiting a licensed crew.

Choice between attachment to individuals or vessels must be made in designing IFQs as well. If the 10,000-ton allowable bycatch for sablefish were allocated as 500 20-ton IFQs, these could be assigned on the basis of historical share to fishermen, to vessel owners, or even to corporations involved in fish processing. With personal IFQs, a trawl vessel owner would need to hire a skipper or crewmember holding an IFQ; with share assigned to vessels the owner would have control of the harvest right and fishermen not owning vessels would be at a disadvantage; and with corporate ownership of shares the processors could more easily plan and manage the fleet fishing for them.

A sub-option for IFQs is partial implementation of the system for a subset of groundfish stocks. One could allocate the estimated annual allowable catch of widow rockfish, sablefish, or Dover sole while leaving other species out of the IFQ system. Also, as suggested by Robert Stokes (1983) in his study of north Pacific halibut, one could establish IFQs for a portion of the total harvest of a given species while retaining a communal fishery for the remainder of the harvest. This option has the advantage of providing a choice to fishermen who, for whatever reason, do not want to join a quantitative rights system. If one-half of the traditional harvesters of Dover sole object to an IFQ system, one could distribute IFQs for half the annual yield to those wishing to join the system. The traditional harvest sector would fish from January 1 until one-half of the annual allowable bycatch is taken. Fishermen with IFQs could fish whenever they wish, and would probably time their harvest to maximize its landed value.

INITIAL ALLOCATION OF FISHING RIGHTS

The FMA/CDA proposal would allocate trawl licenses only to certain groundfish trawlers (1) landing at least 100,000 pounds or (2) making at least 12 deliveries during 1984 or (3) demonstrating to an industry-governing Board that they had prior involvement in the fishery and were active in the north Pacific or Bering Sea trawl fishery in 1984 or (4) demonstrating to the Board that they signed a contract or began construction or conversion of a trawl vessel during 1984. These qualifications would exclude very few groundfish trawl fishing vessels from the licensed fleet. For that reason, this initial allocation of harvest rights would create no significant reduction in harvesting capacity.

Whether licenses or IFQs are considered, the basic choice here is between administrative assignment and some kind of "market allocation." Administrative assignments are universally chosen in existing limited access programs, largely because government agencies (and legislators) are reluctant to take away historically established fishing rights. As noted in the Introduction, when government regulations are designed to correct technical problems of communal resource usage, use rights are generally assigned to actual, historic users in order to avoid causing a redistribution of wealth. However, when developing new resources (offshore oil) or distributing public resources not previously used (National Forest timber), government mechanisms tend to use more market-oriented allocations (auctions and royalties) which extract resource value from the users.

A case could be made that both historic use and new uses are found in the Pacific groundfish fishery. Extensive historic use of most flatfish, rockfish, and sablefish by commercial fishing fleets could establish an informal "ownership" of the right to harvest. At the same time, however, new or developing fisheries have no such specific historic use. Pacific whiting, shortbelly rockfish, sanddabs, and possibly other groundfish stocks would be essentially "new" from this perspective. A mix of administrative and market allocation of initial harvest rights could be justified on this basis. Ultimately, there is no technically correct answer to the initial allocation question. Distribution of public resources can and has been done in many ways.

TRANSFERABILITY OF HARVEST RIGHTS

Under the FMA/CDA proposal, the trawl licenses would be transferred with sale of the vessel and could be shifted from one vessel to another by the owner if the licensed vessel is lost or if the owner wants to "upgrade" or "downgrade" his vessel. Although the license itself would not be saleable under this system, it would be fairly easy to perform almost any kind of transfer. For example,

if a licensed vessel owner wants to take his vessel to a different fishery, he could replace his vessel with another and then sell the new vessel with license. Or, he could sell the original vessel with license to another fisherman, who would then replace the vessel and sell the original vessel back to the original owner. There would be no apparent market value to a license, but the difference between vessel prices with and without a license would provide a good indication of license value. The restriction on sales simply makes transactions involving limited harvest rights a cumbersome and roundabout process.

An alternative to this is a fully saleable license. If sufficient numbers of licenses or quantitative harvest rights (IFQs) change hands on a routine basis, the market allocation of fishing rights would have all the advantages and disadvantages of market allocations that are experienced in sectors of the economy. Market allocations are presumed to facilitate the efficient entry and exit of resource users. Less adept or profitable harvesters would be encouraged to sell their rights and enter a different line of work, while more efficient operators could expand. No coercion would be necessary, since anyone with a license or harvest right would have the option of not selling.

With vessel licenses as proposed by FMA/CDA, sufficient transferability seems to be incorporated. For an IFQ system to work, however, true market sales would be almost a necessity. One alternative is for annual harvest quotas to be initially allocated among vessel owners in proportion to their historic shares. A vessel owner with a vessel that breaks down for an extended time would want to sell any quotas he owns to another operator. Also, a vessel which is harvesting mostly rockfish may want to shift into shrimp or Dover sole fishing. The owner will need to sell one set of quotas and buy a new set. Without the freedom of market sales, it would be difficult to maintain operating flexibility with quantitative harvest rights.

LONGEVITY OF HARVEST RIGHTS

In view of the long-lived investments inherent in both fishing vessels and fishing know-how, there seems to be no logical reason for licenses or IFQs to expire annually or over a short period of years. The FMA/CDA proposal allows perpetual trawl licenses. Only if a vessel owner fails to meet minimum landing requirements and fails to seek an exemption for his vessel, would a license be automatically retired. Personal licenses in Alaska and elsewhere are also perpetual. The Pearse Commission recommended that British Columbia salmon licenses be issued for a 10-year term, but that proposal was part of an intended fleet reduction program that would end with issuance of a smaller number of perpetual licenses.

In a limited access program incorporating all gear types, however, it might be useful to issue short-term licenses to vessels that really intend to fish only for a short time or which temporarily exceed some maximum harvest level allowed for unlicensed vessels. With a fully marketable IFQ system, anyone wanting to temporarily enter or leave the groundfish fishery would have the opportunity to do so.

MECHANISMS FOR ADJUSTING NUMBERS OF HARVEST RIGHTS

Under the FMA/CDA proposal, the number of trawl licenses, once established, would change only where individual owners allowed their licenses to lapse. Because these licenses would be potentially valuable in the future, it would be unlikely that significant numbers of vessel owners would voluntarily withdraw from the licensed fleet. Assuming that there will be slow attrition from the trawl fishery, the FMA/CDA proposal calls for an annual review of the size and condition of the fleet. No specific procedures are included, however, for either causing more rapid decrease in the fleet or for increasing the number of licenses at some future time.

To achieve an economically efficient fleet size, some reduction in number of vessels would be necessary under a license limitation program. On the other hand, an expansion of the currently developable fisheries for Pacific whiting and shortbelly rockfish might justify adding to the fleet.

For fleet reduction, attrition and buyback programs are the only frequently discussed alternatives. For attrition to have much effect, there must be fairly stringent annual requirements for renewal of licenses, and the licenses must not be transferable to new fishermen. This approach, therefore, seems to impose a rather arbitrary distribution of fleet reduction burden among fishermen. Also, while waiting for attrition to take its toll, many fishermen may be led to remain in the fishery when they should not for health or safety reasons.

Buyback of vessel licenses provides a positive means of reducing the number of vessels, but it requires a source of funding. In their extensive review of buyback of fishing rights, Schelle and Muse (1984) found only one that was not a government subsidized program. If Congress and state legislatures are not prepared to provide financing, then fees and royalties from the fishery could be used to create a fund for buyback. A large number of technical issues need to be addressed in designing a buyback system, including (1) determining the target fleet size, choosing (2) whether to buy licenses only or to include vessels and gear, and (3) whether to target the buyback on a specific distribution of vessel sizes and capacities, and (4) determining the specifics of the application and offer system.

One innovative means of reducing vessel numbers was implemented in the British Columbia roe herring license system. The fishery was divided into three sub-areas and each licensed fisherman was allowed to choose one area. Licenses are saleable, however, and a license owner may buy up licenses from all three areas. If management authorities stagger the openings of herring fishing seasons in the three areas, this method of fleet reduction allows consolidation of fishing operations with attendant reductions in fishing costs. Potentially, the total number of participants could fall to one-third the original number. In fact, from 1981 to 1985 the total number of licenses fell from 1,557 to 1,132. As of 1985, only 17 vessels had three licenses. P. MacGillivray (1986) notes that the British Columbia system resulted in both improved product quality and reduced fishing costs.

Under an IFQ system, numbers of participants need not be adjusted directly. Instead, the quota initially allocated will be redistributed in private market transactions to determine the number of participants. With marketable IFQs, adjustment of numbers of vessels or fishermen is not administered by the management program. Nevertheless, ownership of IFQs may be restricted to some defined class of "qualified" fishermen, and the number of such fishermen may be of concern. It is difficult to anticipate what issues

might arise under such a system in the absence of any experience with it or a specific proposal.

HANDLING DISPUTES

Disputes are likely to arise concerning the initial allocation of harvest rights (whether licenses or IFQs), and in exercising the mechanisms for license transfer, renewal and termination. Most existing license limitation programs avoid disputes regarding initial allocation by including almost every conceivable claimant. Alaska's salmon license program did not, much to the chagrin of the Commercial Fisheries Entry Commission. The Alaska system required the Entry Commission to establish means of determining the extent to which applicants met various criteria concerning historic participation and dependence on the fishery. Challenges to the Commission's procedures and decisions still, after 10 years of operation, constitute a significant portion of the Commission's business. This could be avoided by establishing quantitative criteria in law or regulation at the outset, rather than leaving interpretation of some vague criteria to a quasiregulatory body.

To deal with the disputes that occur, several alternative procedures could be established. A review board dominated by fishermen and other industry members could decide whether individuals should be given licenses and whether proposed license or vessel transfers should be allowed. A variant on this is to use the board to make recommendations to an agency administrator (e.g., an NMFS Regional Director) who would make an official ruling. Fishermen affected by decisions of the Board may feel that they will get a more sympathetic hearing before their peers than before a nonfishing administrative or judicial panel. On the other hand, both fishermen and the public-at-large occasionally may fear that conflicts of interest or favoritism are more likely to affect the decisions of an industry-dominated review board.

Other approaches could include use of an Administrative Law Judge to hear evidence and make recommendations or rulings. Agency administrative procedures could be used to hear grievances and make rulings. In any case, a fisherman has access to the courts to seek redress of arbitrary or wrongful actions by the management agency.

CONCLUSIONS

A tremendous variety of combinations of limited access program elements can and have been attempted. This chapter has introduced and explained many of the most commonly discussed alternatives under seven categories. Further innovation in developing variants on these alternatives will surely be an activity for fishermen, managers, and scientists involved in limited access programs.

4

Interaction with Existing Management Measures

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Consideration of fishery limited access leads inevitably to the question of how such a program will interact with existing regulations. Two of the stated objectives of limited access are to (1) reduce the burden of management regulations on the industry and (2) reduce the public cost of regulation. Will such programs result in the removal of some existing regulations? Will remaining regulations be simpler? Or will limited access increase the complexity of regulations by adding a further layer of regulatory and enforcement requirements to those already in place?

The federal regulations for the groundfish fisheries off the coasts of Washington, Oregon, and California are divided into two categories, "general provisions" and "management measures." Only the management measures are relevant to this discussion. They may be subdivided further according to functional type, as measures which:

(1) restrain the rate of catch (trip limits);
(2) limit total catch (optimum yield/quota/harvest guideline);
(3) change the size of fish at capture through either (a) mesh size restrictions, (b) other gear restrictions to make mesh size effective, or (c) size restrictions;
(4) avoid wastage induced by (1), (2), and (3) through (a) sablefish incidental catch allowance in the trawl fishery when 90% of optimum yield is reached and (b) Pacific ocean perch incidental catch allowance (trip limits); and
(5) avoid gear conflict (gear marking requirements).

The following discussion focuses on how well a license limitation program or individual fishermen quota (IFQ) program is likely to meet the goal of reducing the complexity and cost of regulations.

LICENSE LIMITATION

License limitation and management

The type of license limitation program under discussion in this section is that assigning general catch rights which control the number of fishing vessels with rights to fish. This type of program does not in itself control either the type of fishing vessels or the level of fishing effort, which, along with the state of the resource at the time of license implementation, are crucial to the determination of the number and type of regulations required for management. If license limitation does not control effective fishing effort, it will not protect the biological production of stocks. When resource conservation measures are required, measures to curtail fishing effort must be in place. Several factors related to the multidimensional nature of fishing effort contribute to the need for further effort control under license limitation.

A common response to license limitation in a fishery is "capital stuffing," the upgrading of the capital stock of the fleet to more efficient and flexible vessels. Several reasons for this have been enumerated (Townsend 1985), all stemming from the cheaper cost of capital in a less risky investment environment. For example, in some fisheries banks have been willing to consider the value of a fishing license as security in a vessel construction loan. In fisheries where this situation exists, vessels tend to have a higher debt ratio (ratio of loan value to total vessel value) than in unlicensed fisheries. In addition, fleet capacity expands at a more rapid rate than it would without the security of high license values. Another effect of capital

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Table 1—Performance indicators of five license limitation programs.

Fishery	Stability	Level of fishery development	No. of vessels	Fleet capacity and effective fishing effort	No. and complexity of regulations	Fleet profits	Fishermen bargaining power
W. Australia rock lobster (Meany 1978)	Fairly stable	Fully exploited	Increase	Increase	Increase	High and stable	Increase
W. Australia prawn (Meany 1978)	Fairly stable	Undeveloped	Increase	Increase	N/A	High	Processor-owned fleet
British Columbia salmon (Fraser 1979; Rettig 1984)	Variable	Fully developed	Decrease 20% (buyback)	Increase	Increase	Variable	Increase
Alaska salmon (Adasiak 1978; Rettig 1984)	Variable	Fully developed	Decrease	Increase	Increase	Variable	Increase
Japan tuna (first 12 yr) (Keen 1973)	Fairly stable	Developing rapidly	Increase	Increase	Increase	Variable	Processor-owned fleet

stuffing is to increase the fishing power of the fleet even as overall numbers of vessels decline.

Effort control is critical to the control of fishing mortality. The more specific the license, the more direct the connection between restrictions on fishing effort and the control of fishing mortality. In a multispecies fishery fished by multipurpose vessels covering a large geographic area, a license specific to a single species, gear type, or subarea would require an impractical, high level of monitoring. A general license giving fishermen needed operating flexibility will require a lower level of monitoring. However, a general license will also have a smaller impact on limiting fishing effort. There is a tradeoff between the degree of effort control and the cost of enforcement.

The stage in a fishery's development at which license limitation is implemented also affects the number and complexity of supplemental regulations required. License limitation that puts a ceiling on the number of vessels at the early stages of fishery development will, of course, be far more effective at limiting fishing mortality, even with subsequent increases in fishing effort, than will a program implemented after a fishery is fully developed (Rettig 1984). The state of the resource determines whether there is any slack to absorb the increase in fishing effort that will follow license limitation.

Some examples of license limitation programs

A review of some existing license limitation programs offers supporting evidence to the general conclusion that license limitation in itself will not change the number or type of other regulations used to manage the fishery. Table 1 summarizes performance indicators for several fisheries managed under license limitation. It is important to note (cf Rettig 1984) that to compare the levels of regulation before and after license limitation tells us nothing about the number or type of regulations that might be in place had license limitation never been implemented. The histories of fisheries managed without license limitation are also characterized by a tendency toward increased fishing power through more and larger vessels, increased fishing effort, declining fishery profits, and an increasing complexity of regulations over time.

Some general similarities can be seen among the programs. In all programs, regardless of whether the number of vessels has increased or decreased under license limitation, effective fishing effort has increased resulting from internal shifts in fleet structure. Investment of capital in fleets has led to more efficient vessels with upgraded technology and increased capacity.

Once the license to fish is limited, it acquires value which in many cases results in easier access to capital markets by fishermen. In fisheries where prices have kept ahead of rising costs, profits earned by fishermen have also increased, and a substantial proportion of these profits have been reinvested in vessels. Fraser (1978) notes that the investment response to changes in resource value may be even greater under a system of license limitation than under open access because fishermen have a firmer expectation of capitalizing on that investment.

When the vessel composition of the fleet shifts toward more capital-intensive vessels, fishing mobility, operating flexibility, and search efficiency are increased. Unless there has been a substantial offsetting fleet reduction or an increase in the size of the resource base, fishery managers are faced with the need to institute resource conservation regulations to limit fishing mortality. The net result, under both license limitation and open access systems, is that effective fishing effort increases. Further regulations are then required to prevent resource overexploitation. In general, regulations tend to become more numerous and more complex after license limitation programs are in place.

The timing of license limitation in relation to the state of fishery development is of critical importance. License limitation programs instituted in a developing fishery or before serious problems are widespread will likely require fewer additional regulations than programs put in place after problems of overcapitalization and overexploitation are severe. In a fully developed fishery, license limitation in itself will not decrease fishing effort although it may slow the rate of increase in effort. When evaluating the level of regulations required under license limitation programs, the valid comparison is between the number and complexity of regulations at a particular time period to what they might have been had license limitation not been implemented. It is apparent from these five examples of license limitation programs that restricting the number

of general licenses to fish will not reduce the number, complexity, or cost of management regulations.

To summarize, because license limitation does not in itself change either the nature of competition or the state of the resource, it cannot stand alone as a fishery management tool. There is nothing in license limitation that would preclude the continued need for conservation measures such as quotas, trip limits, and gear regulations. License limitation would pose particular problems in the west coast groundfishery. Due to the vast geographic area, multispecies catch, and flexibility of multipurpose vessels, licenses to fish would have to encompass a large number of species and areas. A license limitation program without additional regulations could well serve to increase effective fishing effort through an overall increase in fleet capacity.

Given the current state of some *Sebastes* stocks, an increase in fishing effort under either open access or license limitation would provide the justification for even more stringent trip and trip frequency limits. Effort limitation is a continuing problem even in programs with provisions for vessel buybacks. The need for continuous regulatory measures to limit fishing effort makes it unlikely that either the number or the cost of regulations in the west coast groundfishery would decline under a general license limitation program.

Individual fisherman quotas

IFQs are property rights to given volumes of fish. As such, they can only be expected to resolve problems related to volumes of fish. Thus, the establishment of an IFQ system will have direct bearing on those measures designed to limit the rate of catch and the total volume of catch (regulation categories 1 and 2), but will have no direct bearing on the problems of size at capture and gear conflicts (categories 3 and 5). Similarly, measures to avoid wastage which are tied to volume control (sablefish and Pacific ocean perch incidental catch allowances) are directly affected by IFQs, while those wastage measures tied to control of age at catch (shrimp and pelagic trawl incidental catch allowances) are not affected.

The interaction between IFQs and other groundfish regulations depends on how the IFQs are defined and restricted. For this discussion, it will be assumed that IFQs for key groundfish species have been allocated in some manner to groundfish fishermen, with aggregate IFQs or no quotas at all for the remaining species. It is further assumed that IFQs are divisible into relatively small units and that they are freely transferable. The shares are not "attached" to the vessel or to the vessel owner; they are simply owned, and all that is required is that fish being landed must be credited to a particular owner's account. Finally, it is assumed that the system has been in place long enough for an orderly share market to have developed and for fishermen to have learned how to account for the IFQ system in their planning and other decisions.

This IFQ system, if adequately enforced, will control the landings of key species as effectively as a fleet quota system. However, some concerns have been raised that IFQs will cause discards to increase. This probably would not happen for key species due to the fact that shares may be taken anytime during the year, without fear of fishery closures. Fishermen planning to fish several species at once will have a strong incentive to acquire shares for all the key species they expect to catch. Thus, for example, a fisherman who plans to fish Dover sole in the fall will want to acquire sablefish shares along with necessary Dover sole shares to cover his expected sablefish bycatch. If individual fishermen can predict their catches and can obtain shares at pricing allowing profitable operations, they will be able to land both species with no substantial discards.

Under a fleet quota system the sablefish fishery is likely to be closed during the fall so that any sablefish bycatch during this period would be discarded. The existing modified quota system restricts trawlers to a small incidental per-trip catch of sablefish after 90% of the annual quota is taken. This reduces discards to the amount of bycatch in excess of the trip limit. With the IFQ system, discards of marketable key species will take place only when fishermen underestimate their bycatch and cannot obtain additional shares before returning to port. Given a well developed share market, stable conditions in the fishery, ready access to reliable economic and biological information (e.g., future prices, reliable stock assessments), and rational decision makers (e.g., fishermen, processors, and government regulators), there would be very few such discards.

However, unanticipated fluctuations in species availability and exvessel prices are currently a fact of life for some groundfish species (especially Pacific whiting and sablefish). Significant discards of any species subject to an IFQ or other quota could be induced by such unanticipated changes. In general, however, discards of key species should be less extensive under the IFQ system than under other forms of management, and fishing mortality therefore should be controlled more precisely.

Discards of species covered by aggregate IFQs may be induced by this system if the aggregates include two or more species caught together for which there are significantly different exvessel prices. Under these conditions fishermen might find it profitable to catch both species but discard the less valuable one. This can be prevented by establishing separate IFQs on the key species within the aggregate. It also may be avoided by simply not establishing IFQs for minor species. Since the potential for fishery development lies mostly within the non-key species, these aggregates could simply be left without any kind of quotas. The resulting incentive to fish non-quota species could hasten full utilization.

The major difference between IFQs and the current groundfish management regime which gives rise to the possibility of eliminating some regulations is the fact, already mentioned, that share owners may plan their fishing activities throughout the year without worrying about the fishery being closed before they fill their IFQs. In addition to providing for incidental catch, as described above, fishermen can be expected to respond to seasonal patterns of exvessel prices and costs of harvesting in determining when they will catch their IFQs. Processors will also have an easier time scheduling an even rate of deliveries throughout the year. Consequently, an IFQ system should eliminate the need for government-imposed trip limits to provide for a continuous, steady supply of fish.

The IFQ system could eliminate the need for incidental catch allowances in fisheries where the gear being used is appropriate to the incidental species, as is the case for Pacific ocean perch. Given full access to information and rational profit maximizing behavior, fishermen will provide for an incidental catch of Pacific ocean perch by acquiring shares. Other incidental catch allowances, such as those for shrimp and pelagic trawls, still will be needed because it will be necessary to prevent targeting on most groundfish with small mesh nets.

Insofar as the IFQ system reduces effort in the fishery, it will mitigate gear conflict and age-at-capture problems. However, the need for mesh size restrictions, size limits, and gear marking requirements will persist. As long as the price for fish does not vary by size (over the range normally caught by trawls), it will be more profitable for the individual fisherman to land smaller fish whenever this will reduce his fishing time. This will sometimes involve the use of a smaller mesh net than would be desirable for the economy as a whole. Thus, mesh size restrictions will still be needed. Size

limits may be needed for the same reason, although the price differential by size in the sablefish case is probably great enough in some years to induce fishermen to save their quotas for larger, higher valued fish.

CONCLUSIONS

In summary, a well designed and enforced IFQ system could be expected eventually to supplant quotas or other harvest guidelines and to eliminate the need for trip limits and incidental catch allowances for domestic trawl-caught Pacific ocean perch and sablefish. There will be a learning period following initial IFQ implementation during which these measures may still be required. Other management measures, such as mesh-size restrictions, incidental catch allowances for shrimp and pelagic trawls, sablefish size limits, and gear marking regulations still will be required for good management of the groundfish fishery.

5

Potential Economic Benefits of Limited Entry

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In deciding whether to adopt a limited access system, one consideration would be the economic benefits and costs. To pass the benefit-cost test, the potential economic benefits must exceed the total public and private costs of public program implementation. This chapter summarizes the results of an effort to estimate potential economic returns from the groundfish trawl fishery. Chapter 6 presents available information on possible administrative costs.

The economic benefit calculation is abstracted from Huppert and Squires (1986). Benefits from limited access are presumed to occur through increased economic efficiency in fishing fleet construction and deployment. Thus the estimated benefits are derived from a model which calculates, under stated conditions and assumptions, the total fleet profit possible with an optimal fleet size and optimal deployment of fishing effort.

TRAWL FLEET PROFITS

The mathematical model used to calculate potential economic profits is not intended to describe an actual limited access program. Instead, it computes the optimal solution to the fishing fleet construction and deployment problem as though there is a profit-seeking centralized manager of the fishery. This hypothetical manager operates the fleet as if he is starting from scratch. That is, he does not take into consideration the investments sunk into the existing fishing fleet. Therefore, our estimate of maximum economic returns for the fleet is a hypothetical one, describing an ideal result that could be achieved only after a long period of adjustment. We cannot recommend that the trawl fleet be forced into conformance with our computed optimum fleet by a limited access program. This hypothetical model is useful, nevertheless, because it yields a reasonable estimate of what can be achieved in a commercial fishery when the trawl fleet is managed to maximize economic profit.

The Pacific trawl fishery's optimum economic return is computed by linear programming. This procedure calculates the maximum economic profit available to the entire fleet given that the fleet's total catch cannot exceed allowable catch levels. Vessels with non-trawl gear are assumed to continue catching a portion of the total harvest as observed during 1981-84. To implement the linear program, we have to establish catch rates, exvessel prices, and costs of fishing for trawl vessels. Amounts of fishing effort for vessels in each of five length classes are expressed in number of fishing weeks. Each vessel is assumed to be capable of fishing a certain number of weeks during each calendar quarter. Each element of the model has been derived from data collected during the last few years as summarized below.

Allowable catch levels for eight groundfish species and species groups were adopted from the Pacific Fishery Management Council's (1985) estimates for 1985. The proportion of the allowable catches to be taken by the trawl fleet is assumed to equal the average proportion observed during 1981-84. Pacific whiting presented a special problem because it is taken mainly in the joint venture fishery. We examined three different levels for the joint venture Pacific whiting catch centered on the 1984 harvest level. Maximum annual harvest of pink shrimp by trawlers was set at the average 1981-82 total catch (which is close to the recent 12-year average harvest). The average annual trawl fleet catch in 1981-82 was also used to determine the Dungeness crab allowable catch level. Finally, the linear program-

ming model assumes that vessels do not fish more than the typical number of weeks fished by very active trawlers during 1981 and 1982.

The Pacific trawl fishery is considered to have six distinct production processes or fishing modes: (1) mixed-species groundfish trawling in the Vancouver-Columbia area, (2) mixed-species groundfish trawling in the Eureka area, (3) mixed-species groundfish trawling in the Monterey area, (4) single-species pink shrimp trawling, (5) single-species Dungeness crab pot harvesting, and (6) single-species joint venture fishing for Pacific whiting. Eight species categories are caught in the groundfish modes: Dover sole, other flatfish, cod and lingcod, widow rockfish, other rockfish, whiting, sablefish, and a miscellaneous category. The study considers the four calendar-year quarters and five vessel size classes: (1) 40-49 ft., (2) 50-59 ft., (3) 60-69 ft., (4) 70-79 ft., and (5) 80-95 ft. All lengths are Coast Guard registered lengths.

Multispecies groundfish, shrimp, and Dungeness crab catch rates were obtained from the PACFIN research data base (Huppert et al. 1984) maintained at the Southwest Fisheries Center in La Jolla. Average weekly catches for 1981-82 were computed for each fishing mode, area, size class, and season. Catch rates for Pacific whiting joint venture fishing were based upon information from private companies and financial reports. Cost data covering the years 1980-83 were used to estimate average weekly operating costs and annual fixed costs for each length class. Exvessel fish prices were taken from the PACFIN management data base at the Northwest and Alaska Fisheries Center in Seattle. All of these estimates were combined in the program to compute the fleet's profit (gross exvessel value of harvest minus fleetwide operating and fixed costs) for any combination of weeks fished and number of vessels. To provide a baseline for comparison, the prospective fleet profit was calculated for the 1984 trawl fleet while assuming the pattern of fishing weeks observed for the fleet in 1982. This baseline estimate does not correspond to the actual trawl fleet profit in 1984, but it does offer a representative benchmark reflecting the fleet's current economic status.

Table 1 displays a summary of the main results from the linear program. The first column of data in Table 1, representing the baseline 1984 fleet, shows a $10 million loss under the assumed conditions. Columns 2 through 4 report that the trawl fleet could achieve a total profit of between $7.6 and $17.7 million per year depending upon the size of the joint venture whiting fishery. Without a joint venture fishery, the optimum hypothetical fleet would have 238 vessels and would generate $7.6 million in profits annually. Adding a 1984-level joint venture fishery increases the optimum hypothetical fleet to 265 vessels and the annual profit to $11.96 million. Should the joint venture fishery expand to harvest the entire Pacific whiting maximum sustainable yield, the optimum fleet operated by the hypothetical manager would have 338 vessels earning $17.7 million in profits per year. This indicates that the estimated profit and fleet size are sensitive to the assumed level of joint venture activity, an unsurprising result. Because the joint venture fishery employs foreign processing vessels, however, the likely size of this fishery depends upon domestic politics and foreign economic policies as well as standard economic considerations such as the Pacific whiting price and operating costs.

The most reasonable assumption might be that the joint venture fishery remains at the 1984 size. In this case the optimum fleet would enjoy an increase of over $22 million per year from that of a baseline. Slightly more than one-third of the profit is due to multispecies groundfish trawling, about one-quarter comes from shrimp harvesting, about one-quarter is from joint venture fishing of Pacific whiting, and only one-tenth is from crab harvesting.

Table 1—Results of linear programming for the Pacific trawl fleet. JV = joint venture; MSY = max. sustainable yield.

		Optimum fishery[2]		
	Baseline fleet in 1984[1]	JV takes whiting MSY	1984 JV harvest	With no JV fishery
	Number of vessels			
Class 1	106	0	0	0
Class 2	118	245	180	180
Class 3	138	0	0	0
Class 4	55	93	85	58
Class 5	12	0	0	0
Total	429	338	265	238
	Profit ($million)			
	$-10.25	$17.7	$11.96	$7.61
Proportion from[3]:				
Shrimp fishing	0.324	0.180	0.267	0.362
Crab fishing	0.038	0.081	0.109	0.143
Joint venture fishing	0.306	0.475	0.263	0.000
Groundfish	0.332	0.264	0.360	0.495
	Total weeks			
	11,763	11,034	9,041	8,054
Proportion in:				
Shrimp fishing	0.218	0.320	0.380	0.440
Crab fishing	0.044	0.042	0.050	0.060
Joint venture fishing	0.074	0.280	0.130	0.000
Groundfish	0.664	0.358	0.440	0.500

[1]The 1984 baseline fleet does not represent an optimum distribution of fishing weeks. The number and size distribution of vessels represents the 1984 fleet, while the distribution of weeks fished is taken from the 1982 PACFIN research data base (Huppert and Thomson 1985). All prices and costs used in calculating profits are in 1984 dollars.

[2]Various joint venture harvest constraints all assume pink shrimp harvest constraint equals average 1981-82 catch (17,218 short tons).

[3]This is the proportion of operating profit (or net revenue), not economic profit. Fixed costs of vessels are not allocated among fisheries in calculating this proportion.

The size distribution of vessels in the hypothetical fleet operated by a centralized manager differs markedly from the baseline fleet. The optimum hypothetical fleet is composed of 180 vessels in the 50-59 ft. size class and 85 vessels in the 70-79 ft. size class. Absence of the largest and smallest vessel size classes in the optimum fleet is perhaps not unexpected. The surprising absence of mid-sized trawlers in the 60-69 ft. size class in the optimum hypothetical fleet evidently occurs because the greater harvest rates achieved by these vessels, as compared with 50-59 ft. vessels, do not sufficiently counterbalance the proportionately greater increase in harvesting costs.

The analysis does not consider all important aspects of fishing vessel size, however, and these results should not be taken as definitive regarding optimum vessel size. The linear programming approach, for example, does not consider safety, crew comfort, or seaworthiness of the vessels. It also ignores the flexibility that a large vessel may have for cruising to Alaska and for remaining at sea during storms. Relatively small changes in vessel construction or operating cost may cause the linear program to designate that a given size vessel is more

Table 2—Optimum economic values as trawl fleet size is reduced sequentially while maintaining the 1984 size distribution of vessels. Assumes the 1984 level of joint venture whiting catch, and 1981-82 average pink shrimp catch.

	Trawl fleet size	Total fleet profit	Total revenue	Fixed cost	Variable cost	Total weeks fished
			($millions)			
1984 base*	429	3.6	73.7	27.5	42.6	10,006
−10%	385	5.5	72.4	24.8	42.1	9,883
−20%	343	6.5	70.4	22.0	41.9	9,885
−30%	301	7.1	66.0	19.3	39.6	9,178
−40%	258	7.3	58.3	16.5	34.5	7,970
−50%	215	7.2	49.8	13.8	28.8	6,641
−60%	171	6.9	40.7	11.0	22.8	5,273
−70%	129	6.5	32.4	8.3	17.6	4,049
−80%	86	5.8	24.3	5.5	13.0	2,291
−90%	44	3.0	12.4	2.8	6.6	1,496

*Baseline is 1984 trawl fleet with an optimal allocation of fishing weeks across seasons, areas, and fishing modes.

Table 3—Capacity utilization with 10 to 90% reductions in vessel numbers. Assuming 1984 size distribution of vessels, 1984 level of joint venture whiting catch, and 1981-82 average pink shrimp catch.

	Trawl fleet size	Percent utilization				
		Class 1	Class 2	Class 3	Class 4	Class 5
1984 base	429	79.5	81.5	48.3	69.1	0.0
−10%	385	79.5	98.9	53.1	82.4	0.0
−20%	343	100.0	100.0	65.3	100.0	0.0
−30%	301	100.0	100.0	92.2	100.0	0.0
−40%	258	100.0	100.0	75.8	100.0	0.0
−50%	215	100.0	100.0	75.8	100.0	0.0
−60%	171	100.0	100.0	75.8	100.0	0.0
−70%	129	100.0	100.0	80.6	100.0	0.0
−80%	86	100.0	100.0	100.0	100.0	0.0
−90%	44	100.0	100.0	100.0	100.0	0.0

advantageous than another, while in reality decisions on vessel size must recognize these unquantified factors as well as captain's or owner's preferences.

The level and distribution of weeks fished by fishing mode and vessel size class (aggregated over seasons) also differ between the baseline and optimum hypothetical fleets. The optimum fleet's total weeks fished is 9,041, a decline of about 31% from the baseline. All of the fishing time in the optimum hypothetical fleet is concentrated in the second and fourth vessel length classes: 63% in Class 2, and 37% in Class 4. Several other important changes in fishing patterns occur in the optimum hypothetical fleet: the proportion of weeks fished for pink shrimp trawling increases from 22% to 38% of the total; mixed-species groundfish trawling declines by almost one-third; and joint venture fishing for Pacific whiting almost doubles from 7% of the total to 13%.

Further characteristics of the optimum trawl fleet are examined in detail in Huppert and Squires (1986) referenced above. It is shown that the size of this hypothetical optimum fleet is strongly influenced by the size of the pink shrimp fishery. Also, the conclusions are relatively insensitive to variations in fixed costs, weeks available for fishing per year, and catch rates for Dungeness crab and rockfish. The optimum hypothetical fishery would not fully utilize the available sustainable yields of Dover sole, other flatfish, Pacific cod and lingcod, sablefish, or miscellaneous species. It would fully or nearly completely utilize the sustainable yields of widow rockfish, other rockfish, pink shrimp, and Pacific whiting to the extent permitted by the joint venture fishery.

As noted earlier, these results are pertinent to a hypothetical fleet manager who does not have to deal with the existing trawl fleet. Given the current number and size distribution of trawlers, a manager might suboptimize by deploying the existing fleet's fishing weeks across seasons, areas, and fishing modes. As depicted in the first row of Table 2, this restricted profit maximization generates an annual fleet profit of $3.60 million. The hypothetical central manager might try to expand annual profit by reducing the number of vessels through attrition. We assume that attrition reduces all size classes in proportion. As shown in Tables 2 and 3, the fixed and variable costs of fishing would fall faster than the total revenue earned as the fleet is reduced up to 40% from the base 1984 level. The maximum fleet profit through this attrition program is only $7.3 million.

In evaluating the attrition program, we require that the hypothetical manager pay the fixed costs of maintaining the prescribed fleet, but we do not require that all vessels actually be deployed in the fishery. Some vessels may well be treated as surplus capacity and tied up to the dock. Table 3 shows the percent utilization of the total fishing weeks available to the manager with each fleet size. In particular, this shows that the Class 5 vessels are so uneconomic that they would not be used even though the manager is charged the substantial fixed cost for interest and depreciation. If the Class 5 vessels were not in the fleet, revenue from harvests would be unaffected, but the cost would be reduced by $110,550 per vessel. Without Class 5 vessels, the annual fleet profit would rise to $4.9 million with the 1984 base fleet, and to $8.1 million with a fleet reduced by 40%.

The current fleet is a multipurpose fleet composed of trawlers which, depending upon conditions, might target mixed-species groundfish, pink shrimp, Dungeness crab, or Pacific whiting through joint venture operations. The set of results presented in Table 4 demonstrates the economic importance of maintaining a multipurpose fleet. Columns 1-3 show the optimum vessel numbers, total fleet profit, and weeks fished for three hypothetical specialized fleets harvesting (1) only multispecies groundfish and crab, (2) only pink shrimp, and (3) only joint venture Pacific whiting at the 1984 level. Each of these three separately operated fleets could be profitable. Yet, the sum of the three fleets would contain 149 more vessels, would yield $3.78 million less in annual profits, and would fish 1,061 weeks more than an optimal hypothetical multipurpose fleet. This result suggests that a limited access program seeking to improve fleet profits should not create divisions in the fleet based upon exclusive licensing for groundfish, pink shrimp, and joint venture Pacific whiting fishing.

In summary, the analysis of the Pacific coast trawl fishery suggests a maximum fleet annual economic profit of around $12 million. This represents the total profit that might be attained by a hypothetical central manager designing a new trawl fleet. The maximum economic surplus from this hypothetical fleet occurs with a trawl fleet about 38% smaller than the fleet existing in 1984, with a 23% reduction in weeks fished. Without altering the size distribution of vessels, a reduction of about 40% in the trawl fleet would yield a profit of around $7 million, again assuming the fishing weeks are optimally deployed among seasons, fishing areas, and fishing modes.

Table 4—Comparison of specialized and multipurpose optimum trawl fleets assuming 1984 joint venture (JV) harvest and 1981-82 average pink shrimp harvest.

	Specialized fleets				
	Groundfish/ crab only	Shrimp only	JV whiting only	Total	Change from multipurpose fleet
	Number of vessels				
Class 1	61	0	0	61	+61
Class 2	36	154	77	267	+87
Class 3	0	0	0	0	0
Class 4	42	0	0	42	−43
Class 5	0	0	0	0	0
Total	139	154	77	370	+105
	Profit ($million)				
	$4.12	$0.217	$3.85	$8.18	$−3.78
	Weeks fished				
	4,724	3,929	1,449	10,102	+1,061

NON-TRAWL FLEET

If the entire groundfish fishery is placed under a limited access system, the potential profits would be somewhat larger than that estimated for the trawl fleet alone. During the base period of 1981-84, the fixed gear fleet took the following portions of the total Pacific coast groundfish harvest: 12% of cod and lingcod, 6% of other rockfish, 42% of sablefish, and 7% of the miscellaneous fish. Assuming that the fixed gear fleet would continue to take these portions of the total allowable catches, and that it receives the same exvessel prices as trawlers, the non-trawl gross revenue would be about $3.5 million. Without incorporating non-trawl fishing cost information, we cannot accurately estimate the level of profits that this would generate.

As a first approximation, however, we could assume that profits would be the same percentage of gross revenue (i.e., total exvessel value of harvests) for fixed gear as for trawlers. For the trawl fleet as a whole, profits would be about 17.5% of gross revenue for the optimum fishery. Our corresponding educated guess of non-trawl groundfish profits would be about $605,000.

IMPLICATIONS FOR LIMITED ACCESS

The total potential economic profit of $12.6 million represents an annual commercial profit under very specialized conditions. This is a useful rough assessment of net economic benefit attributable to the harvesting of commercial groundfish. It is not clear, however, that this is a reasonable assessment of potential benefits from limiting access to the fishery. There are two main concerns. First, achievement of this total profit requires a trawl fleet that is substantially different from the fleet existing today. But any real limited access program must begin with today's fishing fleet. Also, without detailed consideration of several additional vessel design factors, one cannot be very confident that these particular changes in vessel size distribution will be as beneficial as the model predicts. Second, the practical means of limiting access cannot literally mimic the centralized decision-maker concept, and hence cannot necessarily result in the level of fleet profits calculated. License limitation, for example, would not result in the optimal deployment of fishing effort that the mathematical model recommends. To achieve the economically optimal deployment across species, areas, and seasons, either the manager must wield incredibly detailed direct control over the fleet or the independent vessel operators must have economic incentives that lead them to the optimal solution. Discussion of these two concerns should place this chapter in proper perspective.

Any limited access system likely to be adopted in a commercial fishery would undoubtedly begin by "grandfathering in" the existing fishing fleet. Thus the optimum vessel numbers and size configuration would not be adopted immediately. A more reasonable estimate of potential profit would be the $7.3 million shown in Table 3. Adding the non-trawl profit to this gives us an estimate of about $8 million per year. This is our current best estimate of the size of potential profits from the fishery under the conditions assumed by our mathematical model.

The second concern is that practical limited access systems may not be able to approximate the optimum fleet management assumed in the model. Experience with license limitation programs, for example, shows that limiting numbers of vessels or fishermen does not effectively limit the level of fishing effort, nor does it necessarily lead to an optimal redeployment of effort to maximize overall economic benefit. Increased investment in fishing capacity by licensed vessels can cancel out the capacity-reducing effects of limiting number of participants, and this will cut into the potential profit. Various restraints may be placed upon fishing capacity in order to prevent this from happening. Improvements in fishing technology, comfort, and safety aboard commercial vessels, however, will all involve capital investments. In the long run we cannot prevent these changes in order to preserve economic profits. Thus it is difficult to imagine a license limitation program that would preserve both economic profits and technological progressiveness.

Of equal concern is the conservation effect of excess fishing effort. Even though their numbers may be limited, the fishing fleets for salmon, halibut, and herring roe (to name just three examples) must be further restricted in order to conserve fish stocks. As explained in Chapters 1 and 4, the limit on licenses helps to create a group of common resource users who may coordinate their actions to optimize the resource harvest. But the act of limiting membership to the group of harvesters does not immediately assure the high degree of cooperative behavior needed to achieve optimum results. The kinds of restrictions placed upon fishing fleets to restrain fishing effort in these circumstances often cause increases in fishing costs. Again, this would prevent the fleet from achieving the potential economic profits. It seems more likely that quantitative harvest rights systems, such as New Zealand's Individual Transferable Quotas (ITQs), will succeed at meeting the multiple economic objectives of an efficient harvesting industry. But there are potential problems with the ITQ system as well, including enforcement and control of discards. Thus the economic benefit estimates developed in this chapter should be taken as a sort of target level which may or may not be achievable with a practical limited access program.

6

Enforcement and Administrative Issues

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In Chapter 5 the potential economic benefits resulting from a reduction in the groundfish fishery fleet size are discussed. Implementing an access limitation program to aid in realizing these benefits would not be without costs. The costs of administering and enforcing the limited access system must not be so burdensome as to outweigh any potential benefits. While accurately quantifying the costs of limiting access is not possible without extensive knowledge of the specific enforcement and administrative procedures required for a given program, some generic problems will be examined below. In addition, information will be presented on mechanisms to deal with these problems derived from an examination of individual fishermen's quota (IFQ) systems currently operating or in the process of being implemented in Canada, Iceland, Australia, and New Zealand. Finally, comments on necessary enforcement and administrative procedures will be summarized for some "sample" programs solicited from enforcement experts familiar with the Pacific Coast groundfish fishery.

LICENSE LIMITATION

License limitation forms of limited access require that records of ownership be maintained, that a mechanism for hearing appeals from individuals denied a permit be set up, and that enforcement personnel easily identify legal permit holders. It is likely that other regulations such as trip limits would continue to be necessary under a license limitation program so that the costs of administering and enforcing the limited access system would be added to existing costs (see Chapter 4).

Initial allocation

When designing a license limitation scheme, one of the first questions which must be answered is who is going to be included and excluded. A number of criteria can be used to make this determination, including ones related to the factors listed in section 303(b)6 of the Magnuson Fishery Conservation and Management Act. Regardless of the criteria chosen, it is important that they be as objective and specific as possible in order to minimize the administrative work load. An example of how the choice of criteria can impact the administrative workload can be found in the Alaskan limited entry experience. In the first limited entry regulations, the past participation provision stipulated that if an individual was excluded in any year by "unavoidable circumstances," he or she would get credit for that year. An unavoidable circumstance was defined as "one beyond control, unforeseen or unavoidable in any way." Twenty-five percent of the denied applications under these subjective criteria resulted in administrative hearings, and there are still people who have not received a final decision on their application but who have been fishing on interim permits since 1975. In subsequent limited entry programs, efforts were taken to make the criteria much more objective. As a result, only about 12% of the denied applications required a trial-like hearing (R. Miller 1984).

Many limited entry programs have begun with a moratorium on new entry, with everyone currently or recently participating in the fishery being "grandfathered in." Moratoriums are viewed as interim steps toward a more structured limited entry program and frequently result in a larger "fleet" than was originally actively fishing. They have advantages in that they clearly identify the pool of fishermen which should be involved in the design and discus-

sion of subsequent limited access measures. Identifying the population of fishermen who will be fishing can also aid in the management of the resource. This has proven to be the case in the mid-Atlantic surf clam fishery. Prior to imposition of the moratorium, there were 650 licenses outstanding, although during many years the active fleet numbered closer to 120. Of the 650 licenses, 145 qualified under the moratorium and 130 fished last year. There is a belief among managers that the moratorium aided in the recovery of the resource (B. Nichols, Northeast Region, Natl. Mar. Fish. Serv., Gloucester, MA. NOAA, pers. commun.).

Monitoring and enforcement

After initial allocation of licenses, a record of transfers of licenses and current permit holders must be maintained. In addition, an administrative procedure must be designed to handle related issues such as monitoring minimum landing requirements (e.g., at least one salmon must be landed to maintain eligibility in the Oregon and Washington salmon moratoria) and new entry provisions. On the west coast, Alaska, Oregon, and California have set up permit boards to address these issues. Enforcement costs should be minimal, as vessels are already being monitored for trip tonnage and frequency limits. In general, however, the more complex a license limitation program, the more difficult it will be to enforce. For example, Alaskan limited entry schemes do not allow temporary leasing of permits because of fear of absentee ownership. In reality, such arrangements do occur and enforcement is difficult.

INDIVIDUAL FISHERMAN QUOTAS

Initial allocation

With a quota share system, initial allocation of privileges would have two parts: First, the criteria for inclusion would be developed; second, a procedure for distribution of shares among participants would be designed. Most quota share systems which have been proposed or implemented have set minimum requirements for eligibility, relying on the marketplace to redistribute the shares as the program progressed. The majority of appeals, therefore, have surrounded the "how much" decisions. Again, the more objective and mathematical the formula for allocation, the smaller the administrative costs most likely will be.

Monitoring and enforcement

Difficulty or cost of enforcement is a commonly cited drawback of quota share systems. Keeping track of an individual's accumulated reported landings and checking for possible violations would require some expansion of in-season data collection and processing efforts. The greater the number of ports, participants, gear types, and modes of distribution (processors, across the dock sales, etc.), the more complex the problem will be. For the groundfish fishery, many individuals land fish in more than one port during a year, requiring a timely coastwide vessel-specific data base.

On the other hand, current regulations on rockfish trip limits require enforcement efforts similar to those that would be required for quota share systems. To enforce a 40,000 or 20,000 pound limit on individual fishing trips requires careful monitoring of the specific rockfish species landed in essentially all groundfish ports in Vancouver, Columbia, and Eureka INPFC (Intl. N. Pac. Fish. Comm.) areas. Also, trip frequency limits (one rockfish trip per week or one every two weeks) requires maintaining in-season records of each vessel's landing. Although an individual quota system would require an expanded in-season monitoring and record-keeping activity, this would be a matter of degree, not a difference in kind of enforcement activity.

One of the problems frequently associated with this form of limited access is the increased incentive for a fisherman to under-report his landings, since when landings equal individual quota, the fisherman's right to fish that species is terminated for that year. However, this incentive probably already exists under the current trip tonnage and frequency limits. A system of allowing for in-season and permanent quota transfers would be essential to help minimize this problem. With the ability to buy additional shares of quota, a fisherman's fishing opportunities would be less constrained, although he would have the additional cost of these shares. Enforcement coverage and penalties for violation would need to be at a level which would act as an effective deterrent to under- or nonreporting.

ADMINISTRATION OF IFQ PROGRAMS AROUND THE WORLD

Canada, Australia, New Zealand, and Iceland currently have implemented some form of IFQ program for selected fisheries. These include Canada's Nova Scotia/Bay of Fundy herring seine fishery, the offshore groundfish fishery, and the West Newfoundland trawl fishery; the Icelandic demersal fisheries and herring fishery; the Australian bluefin tuna fishery; and the New Zealand deepwater trawl fishery. New Zealand is extending its IFQ management (referred to as Individual Transferable Quotas, or ITQs) to all its inshore finfish fisheries as of October 1, 1986. In the following section, the administration of these programs will be examined with respect to the issues raised above.

Initial allocation

It has been stressed that the more objective the formula for allocation utilized, the less likelihood that extensive appeal hearings will occur, thus lowering administrative costs. In the Australian bluefin tuna fishery an effort was made to make qualifying criteria as objective as possible. Out of 200 applications, 143 individuals qualified for quota shares. Many fishermen questioned the level of their initial allocations. Because the allocation formula was very clear, however, only two of the 70 appeals were granted (W. Robinson, Alaska Reg., Natl. Mar. Fish. Serv., NOAA, Juneau, pers. commun.).

An alternative method is to not exclude any existing participant initially and allow reduction of effort to occur through transfer of quotas. This is essentially the route chosen by Iceland, New Zealand, and Canada. However, it does not preclude the need for hearing appeals on the level of quotas issued. For example, the initial allocation in the New Zealand finfish fisheries was based on catch histories from 1982-84. Fishermen were given the opportunity to contest the records of catch based on errors in statistics, changed fishing patterns, or the effects of unavoidable crises. Due to 1,400 of the 1,800 existing fishermen contesting their catch histories and to subsequent review by objections committees, implementation has been delayed over 8 months (Clark and Duncan 1986).

Monitoring and enforcement

One of the critical prerequisites for effective monitoring and enforcement of an IFQ system is industry support for the program.

The more successful examples of IFQ programs, such as those in Iceland's groundfish fishery, Australia's bluefin tuna fishery, and Canada's offshore groundfish fishery, resulted from extensive consultations with industry and began with high levels of industry support.

Several other factors influencing the effectiveness of monitoring and enforcement have been identified from observation of other countries' programs. These include the number of point of landings, number of landings, the amount of processing required, the market structure for the processed fish, the credibility of enforcement procedures to industry members, and the degree of social disruption involved.

Number of points of landing—One of the less successful IFQ programs presently in place has been the Bay of Fundy/Gulf of St. Lawrence herring fishery program. In 1983, the Canadian government instigated an IFQ program for these fisheries. One of the goals was to encourage a reduction in fleet size by making the IFQs freely transferable. Enforcement problems proved monumental during the first two years of the program. This was due, in part, to the nature of the transfer process between harvesters and processors. Some fishermen would offload onto another seiner which would act as a packer for several vessels. Ship-to-shore transfers usually took place by pumping fish from the holds to tanker trucks which would then deliver to the processors. Such transfers required minimal port facilities. Estimates put the actual landings during 1984 at 1.77 times that of the total quota. Little fleet reduction through consolidation of quotas took place during this time since there was little incentive to pay for additional quota shares while enforcement was ineffective. In addition, the level of cheating put the future of the program in doubt, further reducing the incentive to invest in quota shares (B. Muse, Comm. Fish. Entry Comm., Juneau, AK, pers. commun.).

In 1985 a series of administrative steps was taken to address these problems. These included (1) a condition of license requiring a report of the quantity landed, area, and time of fishing; (2) a weekly renewal of this condition of license; (3) authority to demand at time of landing a record of all fish caught, bought, and sold; (4) a requirement that the captain of the vessel provide signed landing slips and log records; and (5) annual licensing, including restrictions on gear and area of activity (Peacock and MacFarlane 1986). Due to these actions, the Canadian Department of Fisheries and Oceans (DFO) estimates that actual landings now are approximately 1.15 times that of the formal total allowable catch, compared with 1.77 times in 1984 (H. Scarth, Canada Dep. Fish. Oceans, Halifax, Nova Scotia, pers. commun.).

Other substantial changes are considered necessary by DFO to fully counteract the severe enforcement and monitoring problems. These changes would require legislative action. First, landings would be required to be weighed using certified bins. This weigh-in would be the responsibility of the processors, but DFO would conduct spot checks. Second, each skipper would be required to report by radio his estimated catch, time of arrival in port, and port of landing, and would have to acquire either written or verbal authorization for unloading. Making an unauthorized landing would be grounds for prosecution. DFO would also have the authority to designate ports of landing.

In contrast, the Australian southern bluefin tuna fishery involves 143 vessels, six or seven ports, four or five major processors, and some at-sea processing and marketing to foreign partners. Managers report that after observers were placed on board every at-sea processor, no significant enforcement problems occurred (W. Robinson, Alaska Reg., Natl. Mar. Fish. Serv., NOAA, Juneau, pers. commun.).

Processed form and market structure—New Zealand managers are extremely optimistic about the extensive finfish IFQ program implemented in October 1986. Among the reasons for this optimism is the fact that the majority of the fish require additional processing and then go to export markets. Consequently, monitoring concentrates on the flow of product through export market channels. Enforcement relies primarily on onshore monitoring mechanisms, although there are observers on vessels larger than 50 meters in length. All fish receivers must be licensed and must have a written record of the quantity of fish bought from each fisherman, a copy of which is forwarded to the regional governmental office. Fishermen also must send in their catch records to a regional office which enters the data on a computer network system linking the ports. The computer record of ITQs are updated weekly. The principal site of enforcement is the licensed fish receiver's office. A record of purchase must be held by the receiver for all fish. Lack of this record is cause for presumption of guilt and grounds for prosecution. A system of auditors maintains and monitors the recordkeeping on sales. About 70% of the inshore fleet catch goes through approximately 35 to 40 licensed fish receivers who are closely monitored on a regular basis. The landing of the remaining 30% is spot checked for compliance. New Zealand fishery managers feel that although it is useful to give the impression of 100% coverage, this is not cost effective, and it is only necessary to control 70 to 80% (I. Clark, Minist. Agric. Fish., Wellington, N.Z., pers. commun.).

Credibility of enforcement program—Programs which have effective landing control systems report few enforcement problems, particularly those systems in which noncompliance can result in stiff penalties, such as withdrawal of quota license. One such program is the Icelandic system, which has agents in each port to record landings, determine the volume of each species, and assess the quality (Arnason 1986). Another problem cited in the Canadian herring fishery is that even when the enforcement personnel apprehended a violator, the courts were reluctant to impose penalties at a level that would act as an effective deterrent (Peacock and MacFarlane 1986).

Another crucial element in the enforcement of management measures is the acceptance of the regulations as "fair." The quota share system was strongly supported by the bluefin tuna fishermen from the start and, indeed, self-policing by the fleet did occur to some extent. If strong acceptance of a proposed program is not forthcoming, however, increased violations should be expected.

ENFORCEMENT OF LIMITED ACCESS IN THE PACIFIC COAST GROUNDFISH FISHERY

To learn more about potential enforcement problems under either license limitation or IFQ programs in the groundfish fishery, the author questioned members of the Pacific Fishery Management Council's committee of enforcement consultants. Committee members, who are enforcement agents with state and federal fisheries agencies, were asked to comment on three hypothetical examples of limited access programs. Three examples were used to make it easier for the enforcement consultants to visualize potential problems with the proposed regulatory tools. Without seeing some

Table 1—Hypothetical examples of limited access programs.

Example 1 **Trawl license limitation program**
- —All trawl vessel owners qualify who have delivered at least 50 mt or 12 deliveries of groundfish in the year prior to implementation
- —Licenses valid coastwide
- —Licenses transferable
- —Trip limits and trip frequency regulations remain in effect

Example 2 **IFQs: Widow rockfish**
- —Total coastwide quota of 9,300 mt divided into 1-mt shares
- —Shares initially allocated to vessel owners on the basis of historical catch
- —Centralized computerized list of vessels with outstanding shares not landed, updated weekly
- —Shares transferable but transaction must be recorded before use
- —Trawl vessels only
- —Fish ticket availability the same as at present

Example 3 **IFQs: Widow rockfish, *Sebastes*, sablefish**
- —Same as above except total quotas for sablefish and *Sebastes* also divided into 1-mt shares
- —All gear types landing >1 mt will be allocated shares

specifics of the program, it would be more difficult for the committee to provide realistic responses. The examples (as shown in Table 1) included one license limitation program similar to the FMA/CDA proposal (see Appendix A), one IFQ proposal for one species (widow rockfish) and one gear type (trawl), and one multigear multispecies IFQ proposal. It should be emphasized that these are hypothetical only.

The enforcement consultants saw no major enforcement problems in the license limitation program outlined in Example 1. They emphasized that the permit should be onboard and the license should be displayed to facilitate at-sea monitoring. Because the fleet is mobile, the consultants thought the program should be coastwide. License limitation was viewed by the majority of the respondents as a useful enforcement tool.

Comments concerning the two IFQ examples are summarized in Table 2. All of the enforcement experts felt the differences in difficulty and expense between enforcing multispecies and single-species IFQs would not be great. However, the administrative burden of providing timely landing records would increase with larger numbers of species. Most of the consultants emphasized the need for accurate and timely by-vessel landings information, extensive enforcement monitoring, and stiff penalties for noncompliance. One suggestion for minimizing the illegal landing of fish was to issue each share in the form of an official coupon to be relinquished at the time of landing or upon transfer of shares to another vessel. Requiring a declaration of landings at least 3 hours prior to arrival in port was suggested as a means to minimize the enforcement burden by allowing enforcement personnel to more closely track vessels. Noncompliance of this landing requirement would be viewed as great a violation as landing illegal quotas.

Most of the enforcement agents were adamant that updated records of outstanding quotas be available at least on a semi-weekly and preferably a daily basis. Only one individual suggested that a weekly update would be acceptable, provided that detailed administrative documentation be maintained in order to prosecute offenders. A NOAA lawyer responsible for prosecuting fishery violations suggested that prosecution not necessarily depend upon an enforcement officer's presence at the time of the offense. Prosecution after the fact for violation of quotas is possible, given an adequate accumulation of data through fish ticket information, etc. This is similar to the current handling of violations of trip frequency regulations.

According to the enforcement groups, the primary costs of implementing an IFQ system similar to either of the examples given would be administrative costs related to maintaining an accurate, timely landing record. One of the greatest problems is data flow. Using the present system of reporting used to generate the PACFIN groundfish management data base, for example, it is doubtful that accurate accounts of landings by vessel could be maintained on a semiweekly, much less a daily, basis.

Discussions with the data manager of the PACFIN system concerning this problem yielded several alternatives which might allow a daily reporting system to be maintained. If the IFQ system was for a small number of species (see Example 2), a monitoring agent could call in a port's landings to a central computer entry person. Vessel name and license number, day of delivery, and pounds landed

Table 2—Summary of comments by enforcement consultants on collection and dissemination of information necessary for effective enforcement of IFQ system.

Item	Information needed	Agency/personnel	Dissemination/timing	Penalties
Status record of IFQ holdings	Report of each vessel should include: name of vessel license number total IFQ by species landings to date date of last delivery	State fish ticket personnel Central computer person Port agent	Coastwide computer network Reports updated at least semiweekly	
Declaration of landing	Port of landing Estimated time of arrival	Radio notification by skipper	Radio in at least 3 h before landing	Noncompliance grounds for prosecution
Transfer of shares	Amount transferred Name and license of purchaser Name and license of previous owner	Transfer request recorded by central computer personnel	Record transfer ~1 week before using shares	
In-port monitoring	Access to updated computerized list On-site weighing of landing	Enforcement officer Seasonal aide with ready access to enforcement officer		Stiff penalties to provide sufficient deterrence, including revocation of quota

Table 3—Estimates of FY86 expenditures for west coast groundfish resource conservation, management and enforcement activities by agency (in thousands of dollars). (From R. McInnis et al. 1986. Draft rep., Southwest Reg., Natl. Mar. Fish. Serv., NOAA, Terminal Island, CA 90731.)

Agency	Resource assessment	Management and enforcement	Direction, coordination, communication	Total
NMFS				
Northwest Region	0	714.5	337.9	1,052.4
Northwest and Alaska Fisheries Center	2,262.7	364.2	503.3	3,130.2
Southwest Region	0	566.8	79.2	646.0
Southwest Fisheries Center	1,089.6	209.4	563.9	1,862.9
Federal assistance to states				
Dingell-Johnson	229.5	0	0	229.5
Coastwide data collection and analysis	0	531.5	0	531.5
Pacific Fishery Management Council	0	126.2	126.2	252.4
Pacific Marine Fisheries Commission	14.0	51.5	0	65.5
States				
Washington	211.3	263.3	68.2	542.8
Oregon	324.0	527.0	3.0	854.0
California	384.1	505.0	100.0	989.1
Total	4,515.2	3,859.4	1,781.7	10,156.3

by species would be reported for each delivery. The main computer system could then generate the report described in Table 2. Such a system would probably require one full-time data entry person and one to two man-months to develop the software for the central system. Alternatively, if more gear types and species were involved, but a monitoring agent was still responsible for documenting landings, computer terminals could be installed in each port and the port sampler could transmit the landing records daily to the central system. Each computer hook-up would cost approximately $500 ($400 for the terminal and $100 for a modem), and telephone charges would accrue on a regular basis.

FUNDING AND GENERAL ADMINISTRATION

The substantial costs of administering a fishery management program are spread among a wide variety of governmental entities and are subject to differing accounting systems. In conjunction with its groundfish planning efforts, the National Marine Fisheries Service, NOAA, recently estimated all expenditures by all governmental agencies for West Coast groundfish resource assessment, management, enforcement, and other activities. The estimated expenditures for fiscal year 1986 are broken down into various entities as shown in Table 3. These estimates do not, of course, contain any expenditures associated with administration of a license or share quota system. Implementation of a limited access program would require additional activities, but might permit reduction of some of the current costs.

License limitation

Regardless of whether a license limitation system was implemented through state or federal authority, there would be some administrative costs associated with it. These costs would likely be highest at the start of the program when there would be the greatest number of appeals resulting from denial of initial applications. Funds for the program could come from state appropriations, federal funds, or through assessment of a license fee. The FMA/CDA moratorium proposal (see Appendix A) suggests a $100 fee per vessel be levied to cover the cost of the industry-governing review board.

In California's salmon troll limited entry program, a $35 annual fee is assessed to cover the costs of a five-member review board and salaries of two full-time staff members. At this point the program is more than paying its way.

As has been mentioned previously, any license limitation scheme for the groundfish fishery would need to be regional in nature, even if it were administered by the states. For consistency in hearing appeals, the review mechanism would most probably need to have members from each state. The Pacific Marine Fisheries Commission might be an appropriate organization to administer funds for such a review board.

Quota share systems

Initially, due to data processing capabilities, the costs associated with implementing a share system could be significant. However, if the quota share system could be implemented without severe enforcement problems, there should be less need in the long run for other forms of regulations necessary under a license limitation scheme to combat the effects of "overcapitalization creep."

The program could be financed either with state and/or federal funds or by the participants themselves. If the latter course was chosen, a fee could be assessed either in the form of a landing tax or a transfer tax on the shares, or some combination of the two.

Managers of several of the IFQ programs in other countries have estimated the cost of monitoring and enforcing their respective programs. The cost of administering the Nova Scotia/Bay of Fundy herring purse seine IFQ program was estimated to exceed $500 thousand in 1985. The total landed value of the fishery was $18-20 million (Peacock and MacFarlane 1986). Both Australia and New Zealand have adopted the position that users should pay a major part of the management cost. In Australia, a levy was introduced in 1985/86 for the northern prawn license limitation program and the southern bluefin tuna IFQ program. This levy was set to recover about $500 thousand or 38% of the estimated costs of managing these fisheries (Lilburn 1986).

New Zealand fishery managers anticipate that the additional cost associated with initiating and administering the finfish ITQ program will be as follows: 1985/86, $587,000; 1986/87 $1,127,000; and after 1987, $477,000 per year. It is anticipated that some user fees will be levied to cover at least part of the cost (I. Clark, Minist. Agric. Fish., Wellington, N.Z., pers. commun.).

SUMMARY

This chapter has examined administrative issues related to the initial allocation of privileges and the monitoring and enforcement of both license limitation and IFQ forms of limited access. Examples from existing programs in other countries were used to explore possible solutions to identified problems.

With respect to allocation of privileges, the more objective the criteria for qualification, the less costly and time consuming will be the administration of initial allocation. Grandfathering in all recent participants may be an administratively easy method of initial allocation, but it can cause a license limitation scheme to have an increased fleet capacity. This is theoretically less of a problem with an IFQ program, because some participants will buy out others to attain quotas which more closely utilize their capacity. In this way overall capacity is reduced. In the Australian bluefin tuna fishery, a 60% reduction in fleet capacity occurred within 6 months after the imposition of the ITQ system (Robinson 1986).

Under a license limitation regime, an administrative mechanism such as a permit board must be set up to conduct an appeal hearing process and monitor other provisions such as minimal landing requirements. Because of the regional nature of the groundfish fishery, such a board might need to be a multi-state operation.

Particularly with an IFQ program, industry support is essential if the management regime is to be feasible. Monitoring and enforcement will be easiest where the number of unloading ports is relatively small (such as with the west coast groundfish fishery), the primary markets are out of the local area, the final product requires some degree of processing, and the level of enforcement and associated penalties are great enough to lead participants to view the program as credible.

Timely data and good administrative records are also extremely important for an effective IFQ program. New Zealand plans on relying heavily on an auditing system tracing the flow of fish through market channels to monitor the inshore finfish ITQ program. In addition, computer link-ups to facilitate quota transfers and official recording of quota accounts will be employed. A quota coupon system was suggested by one of the PFMC (Pac. Fish. Manage. Counc.) enforcement consultants as a mechanism to keep track of quota deliveries and transfers.

Some mechanism for transfer of quotas is essential in order to allow for maximum flexibility for the individual fisherman in planning his fishing operation while reducing the incentive for underreporting or discarding of catch.

The cost of administering a license limitation program is most likely less than that of implementing an IFQ program. However, fewer additional measures such as trip frequency and trip tonnage limits would be necessary under an IFQ program. In addition, without restrictive entry requirements or a fleet capacity reduction program, the existing problem of excess capacity in the groundfish fleet would not be alleviated.

7

Legal Aspects of Effort Limitation

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Whatever the structure of the limited entry program proposed, implementation is dependent upon the legal system for support. The degree of acceptance among participants will be reflected in frequency of legal challenges and court tests, and the probable success of such tests must be a serious concern in program design. These issues obviously extend into the areas of political and administrative feasibility as well. The purpose of this chapter is to explore some of the legal questions of concern when considering alternative forms of efforts limitation. The discussion will focus primarily on license limitation and quota share concepts.

Fishery-related license limitation programs during the past 30 years have been subject to numerous legal challenges. There remains little question that the concept of limited entry in general is legally regarded as a legitimate management tool. However, the specific characteristics of any given program must fall within certain constitutional and procedural constraints.

MAGNUSON FISHERY CONSERVATION AND MANAGEMENT ACT

The MFCMA specifically gave the regional councils authority to design and, through the Secretary of Commerce, to implement mechanisms for limiting access to a fishery in section 303(b)6 which states:

"Any fishery management plan which is prepared by any council, or by the secretary, with respect to any fishery, may . . . (b) establish a system for limiting access to the fishery in order to achieve optimum yield, if, in developing such system, the Council and the Secretary take into account—

(A) present participation in the fishery,
(B) historical fishing practices in, and dependence on, the fishery,
(C) the economics of the fishery,
(D) the capability of fishing vessels used in the fishery to engage in other fisheries,
(E) the cultural and social framework relevant to the fishery, and
(F) any other relevant considerations."

To date, there have been only two federal programs approved: a moratorium under the Mid-Atlantic Council's surf clam and ocean quahog fishery management plan, and a troll salmon license limitation program implemented through the North Pacific Council. Although both of these systems are based on license limitation, the Senate Report discussing Section 303 before its enactment (Senate Committee Rep. 94-416, 1975) lists quota share, taxes, and fees as limited access tools which might become useful upon refinement. While the report indicates an intent by Congress that design of such systems be allowed, it also suggests that limited entry be used carefully and, preferably, when other management techniques are inadequate.

In a memorandum to the National Marine Fisheries Service Alaska region and the North Pacific Fisheries Management Council, providing a preliminary legal analysis of an individual quota system proposal, one of the NOAA regional attorneys suggested that the criteria listed in Section 303(b)6 must be taken into account but not necessarily accommodated in a limited access measure. He urged that the record of Council deliberation over any limited access

system clearly show that the criteria were carefully considered and include the rationale for inclusion or exclusion.

Any fishery management measures, including limited entry programs, must also comply with the National Standards set forth in Sec. 301(a) of the MFCMA. Standards 4 and 5, in particular, place substantive constraints on any limited entry proposal; the administrative record of decision must demonstrate that the proposed limited entry scheme meets these criteria or the scheme cannot be approved by the Secretary.

National Standard 4 states that conservation and management measures shall not discriminate between residents of different states. If it becomes necessary to allocate or assign fishing privileges among various U.S. fishermen, such allocation shall be (A) fair and equitable to all such fishermen; (B) reasonably calculated to promote conservation; and (C) carried out in such a manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges.

National Standard 5 states that conservation and management measures shall, where practicable, promote efficiency in the utilization of fishery resources; except that no such measure shall have economic allocation as its sole purpose.

GENERAL LEGAL CONCEPTS

Due process

Maintenance of an extensive administrative record of the development of a limited entry system is also important to demonstrate that the system meets the United States constitutional requirements of due process. The due process clause states that "no person. . . shall be deprived of life, liberty, or property without due process of law." While legal challenges to restrictions on occupational access as an infringement on personal liberty have generally been unsuccessful, it is necessary that the rationale behind the limitation be clearly and rationally related to the objective for the action, in this case fisheries management. [See *Corsa v. Tawes*, 149 F. Supp. 771 (D. Md.), *a'ffd*, 355 U.S.C. Sec. 34 (1957), upholding a Maryland statute which prohibited the harvest of menhaden by purse seines, finding that the legislative means chosen were rationally related to the objective of protecting the recreational fisheries.]

The due process clause also requires that procedural safeguards be afforded to those whose rights are affected by the limited entry scheme. The procedures are required to prevent arbitrary government actions and to ensure that fair and accurate decisions are rendered when liberty or property interests are involved. Due process is a flexible concept and the degree of procedural protection required may vary depending on the nature of the private interest involved, on the risk of an erroneous decision under the procedures used compared with the value of additional procedures, and on the government interest in avoiding unnecessary, costly, and burdensome procedures.

While it is impossible to state what procedures are required in the absence of a concrete proposal, several generalizations can be made. Where existing rights are not affected, i.e., existing participants are "grandfathered in," there would not be a due process problem. However, greater procedural protections would be required when existing rights are affected rather than "grandfathered;" for example, by an entry proposal that either eliminates existing excess effort capacity or contemplates revocation or modification of entry permits. Less procedural protection would be required for decisions on new entrants, since the new entrant's interest is more speculative than that of existing license holders.

Prior notice and formal trial type hearings are generally required where important interests are involved, if the decision turns on individualized questions of fact. Examples are entry qualifications based on past dependence on the fishery, hardship exemptions, or the types of questions involved in a license revocation for fishery violations. The hearing must precede the license deprivation unless a compelling public interest in delaying the hearing can be shown. Sufficiently compelling reasons are uncommon.

More informal procedures are allowed if the decision is based on objective, mechanically applied standards, such as entry qualifications based on years of experience or years of participation in the fishery. The more objective the criteria, the greater the chance that summary procedures will be acceptable, since objectivity enhances the accuracy of the decision, making more formal procedures unnecessary. The criteria must, however, still be rationally related to the objective sought; oversimplification may increase the risk of the criteria being found an irrational means to the legitimate end of fishery management.

Due process also requires the decision to be fair. Generally this means the decision-maker must be free from conflicts of interest or bias towards the party involved. In most cases a generalized interest, such as being a member of the regulated group, does not create a conflict, while a specific personal interest, such as direct monetary interest in the outcome, will violate due process. State and federal laws differ somewhat on what constitutes fair procedure, with many states having stricter standards (e.g., Washington requires that in addition to actual fairness, the hearing must also appear to be fair). These differences must be taken into account if state, rather than federal, programs are chosen.

Equal protection

The 14th amendment to the Constitution states that "No state shall make or enforce any law which shall. . .deny to any person within its jurisdiction the equal protection of the laws." Accordingly, any state or federal limited entry program must pass a "rational basis" test to comply with equal protection criteria. That is, the classifications for allocation must be rationally related to the statutory purposes of fishery management and must treat all individuals within any given classification equally. Again, although limited entry programs will most likely be evaluated against a fairly lenient rationality test, the greater the care taken to make clear the relationship between the fishery management objectives and the means to reach that objective, the greater the likelihood that the court will uphold the management measures.

Discrimination between residents

Whether effort limitation legislation is implemented on an individual state basis or regionally by an amendment to a federal fishery management plan, care must be taken that provisions do not discriminate between residents of different states. The privileges and immunities clause and the commerce clause provide the constitutional basis of this requirement (Koch 1985). These provisions require that there be no undue discrimination against nonresidents and that excessive burden on interstate commerce not be tolerated. As indicated above, with respect to implementation of a federal limited access scheme in the 3-200 nautical mile Exclusive Economic Zone, the MFCMA also prohibits discrimination between residents of different states (Sec. 301[a]4).

The "taking" question

In addition to the due process clause, the fifth amendment also states "...nor shall private property be taken for public use, without just compensation." The issue of whether a share quota system of limited access creates property rights which, if altered, would have to be compensated is controversial and deserves additional legal analysis. Careful drafting of limited entry provisions would likely avoid this problem by providing advance notice that shares are subject to modification based on legitimate management needs. Termination of shares presents a more direct question, and compensability would depend on the reasons for termination and the type of share system involved. For example, non-renewal of a temporary certificate would probably not require compensation, but revocation of a permanent certificate without cause might be compensible.

Fleet capacity reduction programs

Frequently the number of vessels initially eligible under a limited access program is greater than the optimum fleet size. One mechanism utilized to subsequently reduce the fleet capacity is a vessel or license buy-back system. When a buy-back program was being designed for the northwest salmon fishery, additional implementing legislation (the Salmon and Steelhead Conservation and Enhancement Act) was passed. The MFCMA does not explicitly provide for the implementation and financing of a buy-back program in conjunction with a limited access program at this time.

Other applicable law

For a federal limited entry system to be implemented through the plan amendment process, compliance is required with other applicable legislation such as the Regulatory Flexibility Act (RFA); Executive Order 12291 (E.O. 12291); the National Environmental Policy Act (NEPA); the Coastal Zone Management Act (CZMA); the Administrative Procedures Act (APA); the Endangered Species Act (ESA); and the Marine Mammal Protection Act (MMPA).

The RFA requires that an analysis of the impacts on small business of any proposed regulation be made which includes a rationale for the proposed regulation, an estimate of the number and type of small entities which will be affected, an assessment of the costs imposed on these small businesses, and a discussion of alternatives to the proposed rule which could achieve the same objectives.

E.O. 12291 requires that the limited entry program will help achieve the maximum net benefits to society from the resource and that the least burdensome regulations to achieve such benefits will be imposed.

NEPA requires all federal agencies to assess the environmental impacts of their activities. An environmental impact statement (EIS) must be prepared for all major actions with potential significant impacts on the environment. An amendment to a Fishery Management Plan (FMP) imposing a limited entry system would require an environmental assessment and probably an EIS. An EIS must discuss the environmental impacts of the proposed actions and must explore possible alternatives, assessing the impacts of each alternative as well. Since the process is intended to promote environmentally sound decision-making, preparation of a draft statement should be done as early as possible for use in decision-making. The statement must be circulated for comment to other federal and state agencies as well as to the public. After consideration of the comments, a final statement must be issued before any action is taken. Failure to comply with NEPA procedures could result in suspension of the action pending NEPA compliance. Most states have their own versions of NEPA which must be complied with if a limited entry program is implemented through the states.

The CZMA was enacted to encourage coastal states to formulate coastal zone management plans to establish general land- and water-use policies and goals which are implemented on a local level. Once the plans are in place and approved by the Secretary of Commerce, federal activities directly affecting the coastal zone must be consistent to the maximum extent practicable with the state plans. A "consistency determination" must be prepared, identifying the direct effects contemplated and describing how the activity has been tailored to achieve consistency. State-implemented limited entry programs must also comply with applicable state coastal zone policies.

The APA provisions on notice and comment rulemaking are incorporated into the MFCMA at Secs. 304 and 305. Any federal limited entry regulations must be preceded by a notice of proposed rulemaking published in the *Federal Register* and an opportunity for public comment on the proposed rules. Following consideration of the comments, the final rules must be published along with a concise general statement of their basis and purpose at least 30 days before they take effect. Unless notice and comment requirements are waived for good cause, rules enacted in violation of the APA are invalid.

The APA provisions on formal adjudication are incorporated into the MFCMA at Sec. 308. Any civil penalty proceeding for violations of MFCMA regulations, including limited entry regulations, requires notice of the proceeding and opportunity for a trial-type hearing before the penalty can be imposed. Most states have APAs which would impose similar requirements on state-implemented limited entry programs.

The ESA prohibits federal actions which would jeopardize the continued existence of endangered or threatened species or the degradation of their critical habitats. The EIS accompanying the program must assess its impact on endangered or threatened species. Again, states may have similar or more restrictive laws with which state-implemented programs must comply.

The MMPA creates a general moratorium on the taking of marine mammals. There is an exception to accommodate the incidental catch of some marine mammals in commercial fishing (50 C.F.R. Sec. 216.24). Any limited entry proposal must comply with the general moratorium, the limited regulatory exceptions relating to incidental catches under general permits, and the certificate of inclusion in the permit for each commercial fishing vessel.

If the record on which the access system is based does not demonstrate that the requirements of these statutes are fulfilled, the limited access measure will be denied. An example was the rejection by the Office of Management and Budget (OMB) of the North Pacific Fishery Management Council's approved moratorium for the halibut fishery. The reasons cited for denial in a letter from OMB to John Byrne, Administrator of NOAA, include inconsistency with E.O. 12291 and a concern that the moratorium would prevent consideration of long-term solutions such as the share system.

IMPLEMENTING AUTHORIZING LEGISLATION

Regardless of whether state or federal legislation is sought, the road toward implementation will be relatively arduous and, without substantial industry support and active involvement, impossible to pass. A federal system might be preferred due to the regional nature of the groundfish fishery and the need for coastwide consistent regulations and information. On the other hand, existing limited entry programs are state administered, and the infrastructure needed to conduct these programs is already in place on a state level. In addition, the states have been reluctant to relinquish such authority to the federal government in the past (i.e., when the Pacific Fishery Management Council was considering a regional troll salmon moratorium). Whichever path is chosen, should the decision to pursue limited entry be made, certain procedural steps must be followed. In the sections below are outlined the procedural steps which must be followed.

Federal

Imposition of a federal limited entry program would require a groundfish plan amendment. The entire process is approximately a 15-18 month task. If a large amount of controversy and changes occurred as a result of the public hearing, the time needed for implementation would be extended.

At this time, the MFCMA does not explicitly allow for a buyback program. If such an effort-reduction measure was desired, it might require additional legislation by Congress.

State

In order to have a regional license implemented through state legislation, all three pieces of authorizing legislation would need to be substantively identical. As the Fisheries Marketing Association discovered during the 1985 legislative session, obtaining similar legislation from three different state legislatures is a time-consuming process requiring a large amount of coordination. One mechanism to make this task more feasible is the recently-formed Pacific Fisheries Legislative Task Force composed of two state senators and representatives each from Washington, Oregon, California, and Alaska.

SUMMARY

This chapter explored the legal mandates and concepts which must be taken into account when designing any limited access system. The MFCMA gives the regional councils the authority to design mechanisms to limit access to fisheries under Sec. 303(b)6, but it lays out specific criteria which must be taken into account. In addition, National Standards 4 and 5 can place substantive constraints on any limited entry proposal and the record must show that these standards are specifically met.

Constitutional requirements which must be adhered to include the right to due process, the right to equal protection, and the provision that no undue discrimination against residents of different states occurs or excessive burden is placed on interstate commerce. It is essential that the administrative records show that these requirements were considered during the design and implementation of the program. If IFQs are considered a property right and the level of quotas is reduced, the portion of the fifth amendment which disallows the taking of private property might also have to be addressed. Careful drafting of limited entry provisions would likely avoid any problem by providing advance notice that shares are subject to modification based on legitimate management needs. In addition, any federal management measures implementing limited entry would have to show compliance with other applicable laws, as is required of all amendments to Fishery Management Plans.

Authorizing legislation for groundfish effort limitation programs could be sought either federally through the Council system or by coordinated state legislation. Due to the regional nature of the groundfish fishery and the need for a coastwide consistent program, a federal program implemented through plan amendment might be desired. On the other hand, existing limited entry programs are state administered. In the past, the states have been reluctant to relinquish such authority to the federal government.

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Summary and Postscript

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The seven main chapters of this report cover the following topics: (1) the concept of limited access; (2) rationale for considering limiting access in fisheries generally and in Pacific coast groundfish specifically; (3) the broad range of alternative forms of limited access available; (4) trade-offs between limited access and other forms of fishery regulation; (5) potential economic benefits; (6) enforcement and administrative considerations; and (7) legal issues and requirements. The Citations section contains most of the existing literature concerned with development and implementation of limited access in fisheries. Appendix A reproduces the trawl license system proposed in 1984 by the Fishermen's Marketing Association and Coast Draggers Association. Those readers requiring a brief overview of the content of this report may benefit from the following summary and this author's brief perspectives on the study effort.

SUMMARY OF PREVIOUS CHAPTERS

Concepts of limited access

To effectively conserve fish stocks, all forms of fishery regulation must control fishing effort and fishing mortality by modifying the conditions under which fishermen are allowed access to the fish. Common fishery regulations, such as annual quotas, size limits, gear restrictions, and area closures, control fishing effort by reducing the catching power of fishing gear or the time and area over which fishing is permitted. Limited access may also be used to reduce fishing effort, although it differs from traditional regulations by restricting fishing privileges to specific individuals or firms. In other words, a limited access system (1) identifies who is permitted to harvest fish and (2) specifically controls the number of permittees.

Both license limitation and individual fishermen quotas (IFQs), the most common forms of limited access, involve an initial allocation of fishing privileges which subsequently restrains the level of participation in a fishery. With license limitation the fishermen, vessel owners, or firms assigned fishing rights are not explicitly limited to any given quantity of harvest. An IFQ system assigns quantitative harvest rights to individuals. These harvest rights may be fixed for long periods or annually recomputed as a share of the fishery quota. Both licenses and IFQs may be tied to the initial licensee or may be transferable at the discretion of the owner. A limited access system may be used in combination with or instead of traditional fishery regulations.

Rationale for limiting access

A wide range of objectives may be addressed through limited access. Nine main objectives, discussed in Chapter 2, are to (1) promote economic efficiency in harvesting, (2) establish secure tenure in the fishery for fishermen, (3) enhance the value of fishery products, (4) increase and stabilize profitability in the fishing fleet, (5) reduce the burden of regulations on the fishery, (6) reduce the costs of fisheries management, (7) secure an equitable division of benefits from the fishery, (8) protect various segments of the fishery from other fishermen and noncommercial interests, and (9) help restrain fishing effort to conserve fish stocks. Clearly, not all limited access programs can or will accomplish all these objectives. Also, most of these objectives can be addressed by other kinds of regula-

tions. The reason for considering limited access as a major part of the fishery management program is that it uniquely addresses the widespread problem of overcapitalization and economic inefficiency in fishing.

In contrast to most private property resources, common property fish stocks are not adequately conserved under competitive free enterprise. With open access to fish stocks, fishing firms have little control over total harvests in the fishery, and they have no assurance that conservation actions involving private short-term sacrifice will result in benefits to them in the longer term. The failure of private economic self-interest to assure biological conservation is clearly the principal reason that traditional fishery management is initiated. While annual quotas, season closures, and gear restrictions may prove adequate to reduce fishing mortality and maintain fish populations, these traditional regulations do not restrain the incentives to "race for fish" by expanding fishing capacity.

By requiring that a new entrant to the fishery obtain either a license or an IFQ, a limited access system will prevent new vessels from rapidly expanding a fishing fleet, and may reduce the incentives for existing fishermen to expand fishing capacity beyond that justified by economic considerations. The degree to which this occurs under limited access to a fishery depends upon the specific circumstances. Generally, IFQ-type systems are expected to perform better than license limitation in encouraging private harvesters to eliminate excessive investment in fishing capacity.

Because limiting access does not remove reasons for public participation in fishery regulation, government agencies and interested public groups will continue to be active in managment. All forms of public regulation are costly in agency budgets and in time spent on decision-making by official commissions, by industry representatives, and by the general public. Whether limited access is justifiable in a particular circumstance depends partly upon whether the economic returns in fishing can be improved sufficiently to justify the management costs. If a particular industry does not exhibit excessive investment, economic inefficiency or instability due to free access, then the cost of establishing limited access would not be justified by potential economic benefit.

As noted in Chapter 2, the Pacific groundfish fishery exhibits some of the economic maladies that limited access could address. Rapid growth of the fishery during 1976-82 was followed by a short period of severe economic stress. Overbuilding of the trawl fleet, collapse of the pink shrimp fishery, reduced market prices, and declining annual yield of rockfish species all conspired to cause a significant exit of vessels via bankruptcy and migration to other fisheries. The economic status of the fishing fleet has improved since 1984, but a repeat of that economic strife is a clear possibility. Whether limited access can remedy these economic problems without introducing new problems of equal concern is a central issue in the discussion of limited access.

Alternative limited access systems

Chapter 3 contains an extensive introduction to the elements of limited access programs. Each element is explained by reference to the trawl license moratorium proposal by the Fisherman's Marketing Association and Coast Draggers Association and to other alternatives from the literature on limited entry. The discussion shows that a very wide range of options is available for developing a program tailored to the particular needs and situation of a fishery. The options are organized into the following seven categories:

(1) scope of the fishing activity to be restricted;
(2) method of limited access (licenses or IFQs);
(3) initial allocation of harvest rights;
(4) transferability of harvest rights;
(5) longevity of harvest rights;
(6) mechanisms for adjusting the number of licenses; and
(7) handling disputes regarding issuance and transfer of rights.

The range of alternatives under each category is briefly suggested by the examples listed below.

The scope of a limited access program could be based upon a biological stock or group of stocks, a logical geographic range, a particular gear type, or combination of these factors. The means of limiting access are (a) license limitation, (b) individual fishermen quotas, and (c) taxes or royalties on catch. Although use of royalties on fish catch has been widely discussed in academic circles, this is considered an impractical way to introduce limited access in groundfish, based upon fairness and administrative feasibility. Imposition of royalties would immediately reduce incomes of fishermen who are generally just breaking even under open access competition, and would drive many out of business without compensation. Also, since the proper royalty should reflect the economic value of conserving fish stocks, it should vary substantially over time. Under existing legislative rules, this would be difficult to accomplish. Consequently, the discussion focuses only on license limitation and IFQ options.

Licenses may be assigned to individual fishermen, to vessel owners, to fish processing firms, or to other entities. These same options apply to licenses with a quantitative share attached (IFQ). The quantity may be fixed in perpetuity, or it may be adjusted annually based upon the status of the fish stocks, or it may be adjusted based upon the owner's past performance. All of these various definitions and restrictions on the nature of the fishing right have been suggested or tried in actual limited access systems.

Licenses or IFQs could be allocated to all past participants, to only those past participants meeting some minimum landing requirement, to all those paying a given fee, to the highest bidders in an auction, or to the winners of a lottery. Initial allocation tends to be more troublesome in a fully developed rather than a newly developing fishery. Past users do not have legal rights to the public fish stocks, but they must be dealt with in a clearly even-handed and rational manner. Almost all license limitation programs have started by "grandfathering in" all those having evidence of past participation. In the few examples of license limitations being implemented at the start of a fishery, the initial allocation has been based upon objective qualifications or "first-come, first-served."

Transferability tends to be a heated and sometimes divisive issue. Nontransferable licenses are generally extinguished when the owner leaves the fishery; the state may reissue the license to a qualified new fisherman. Transferable licenses are normally restricted to particular gear types (e.g., a power troll license cannot be used to operate a purse seiner), and are often limited to vessels of equivalent fishing capacity. Some licenses are attached to vessels and can be

transferred only with sale of the vessel. Most economists, and many participants in established license limitation programs, insist that limited harvest rights should be saleable at the discretion of the owners. Voluntary exchange between competent individuals is assumed to be as rational a form of reallocation as is likely to occur. The most frequent counter-argument contends that market prices of transferable licenses represent an unearned and unjustifiable windfall to the original owner, and that the purchase of a license becomes a barrier to entry of new fishermen.

Licenses and IFQs may be good for a single year, for several years, or in perpetuity. Because limited access systems are generally adopted to provide stability and secure tenure for fishermen, most license systems have perpetual licenses. To reduce the number of outstanding harvest rights, therefore, requires that the number of owners be reduced through attrition, administrative revocation, or repurchase. Attrition would work only for nontransferable permits, and revocation generally requires due process and sufficient cause. Neither of these processes can be controlled to achieve a target fishing capacity. Where a reduction in fleet size or fishing capacity is desired, existing licenses can be bought by public agencies, a process normally called "buy-back." Where an increase in number of licenses is desired, new participants can be selected by lottery, by "first-come, first-served," by sale at a posted price, by auction, or by lottery.

Disputes can be expected to arise from the initial distribution of fishing rights, from the transferal of rights, and from the revocation of rights for cause. Well-known dispute settlement procedures are available for limited access systems. These include state and federal courts, administrative law judges, special appeals or review boards, and agency administrative decisions. The important point is to anticipate disputes over licensing and to establish a legal procedure in advance with the hope that administrative costs of dealing with disputes will be reduced.

Limited access and other fishery regulations

To achieve a reduction in either the burden of regulations or administrative and enforcement costs, a limited access program must make it possible to reduce other regulations or to reduce the monitoring and enforcement effort. In Chapter 5, Wes Silverthorne and Susan Hanna review regulations pertaining to the Pacific groundfish fishery in 1986, and draw upon experience in five existing limitation programs to anticipate what regulations might be removed or simplified under limited access. Existing regulations include quotas and harvest guidelines intended to control overall fishing mortality; limits on catch per trip (called "trip limits") intended to lengthen the season on rockfish; incidental catch trip limits intended to control discards of incidentally caught sablefish and Pacific ocean perch; minimum cod-end mesh size restrictions intended to adjust size-at-capture, and other restrictions on trawl gear to make the mesh size regulations effective; and measures to avoid gear conflict (e.g., marking requirements on fixed gear).

The literature regarding license limitation programs combined with past experience in Australia, Japan, British Columbia, and Alaska lead the authors to conclude that license limitation is unlikely to provide much relief from the existing regulations. Both economic theory and experience show that limiting the number of fishing operations does not directly limit fishing effort. This is especially true when all past participants in the fishery are "grandfathered" into the license system. Licensed fishermen will expand the fishing capacity of the existing fleet when there are economic incentives to do so. But fishing effort must be limited in order to control fishing mortality and conserve fish stocks. Consequently, a license limitation system in Pacific coast groundfish is not expected to alleviate the need for effort-controlling regulations such as annual quotas and trip limits.

In contrast to limited licenses, IFQs will act to limit the amount of fish landed. The establishment of an IFQ system should have a direct bearing on the use of closed fishing seasons to enforce quotas and on the use of trip limits to lengthen the fishing season. Because they limit only the landings of individual participants, the IFQs cannot address management objectives related to gear conflicts, fish size, or discards. Thus an IFQ system promises to reduce the need for certain regulations, but leaves untouched the need for regulations designed to control aspects of the fishery unrelated to quantities of fish landed. In general, the IFQ alternative is more likely to reduce the need for other regulations than the license limitation alternative.

A crucial consideration is the amount of fish discarded by commercial fishermen under an IFQ system. Current efforts to reduce the discard of incidentally caught fish are reflected in small trip limits that are imposed during the season after most of the quota has been landed. In 1985, for example, trawlers were limited to 3,000 pounds of sablefish per trip after 90% of the annual quota was reached. This species of fish would still be discarded if the fisherman does not have a market for the fish and if the incidental catch exceeds the allowable level after the incidental trip limit is imposed. IFQs may cause an increased incidence of discards. Clearly, when a fisherman has no more IFQ left for sablefish, he will not land even the incidental catch allowance. Thus it may be desirable to either continue incidental allowances after IFQs are exhausted or to assure that an active market for IFQs provides an opportunity for fishermen to land the fish that they catch. If the IFQ market is successful, incidental catch regulations may become unnecessary.

Potential economic benefits

Because economic benefits associated with increased efficiency in harvesting under limited access are expected, the estimated economic benefit calculated in Chapter 5 is an important consideration. The linear programming model reported in that chapter determines what fishing effort level and pattern of deployment among alternative modes by the trawl fleet will maximize the fleetwide profit. The model combines the best data available on fishing costs and prices with estimated catch rates derived from fish landings information. The profit for the fleet is simply defined as the sum of quantity caught times price in each species category minus the operating and fixed costs for the fleet. It is assumed that the fleet is restricted to taking no more than the acceptable biological catches and/or maximum sustainable yields reported by the Groundfish Management Team in 1985.

Given that the joint venture Pacific whiting fishery remains at about its level in 1984 and that the pink shrimp trawl fishery continues at a level equal to a recent 12-year average, the calculation shows that the fleet could earn an overall profit of about $12 million. This represents the total profit that might be attained by a hypothetical central manager who chooses a fleet composed of just the right size composition of trawl vessels and who operates a trawl fleet strictly for profit. The optimum fleet so defined would be about 38% smaller than the trawl fleet operating in 1984. If the manager were allowed only to reduce the total size of the fleet from the 1984 level without changing the size composition, the maximum profit would be $7 million and the optimum fleet would be 40% smaller

than in 1984. A rough estimate of potential profit from efficiently managing the non-trawl fleet would give another $0.6 million.

Estimated economic profit is an important consideration because it tells what might be earned to offset any administrative and enforcement costs associated with a limited access system. However, the estimates presented in Chapter 5 should not be viewed as economic benefits that necessarily result from limited access. The $12 million trawl fleet profit represents a best guess regarding maximum profit under ideal circumstances. These ideal circumstances could not be replicated by a license limitation system of any kind, especially one that "grandfathers in" all existing trawl vessel operators. Limiting the number of participants in the fishery will place a rough upper limit on fishing capacity, but it will not remove the economic incentives of individual operators which result in "capital stuffing" associated with the competitive race for fish. With IFQ management, the individual operator's profit incentives would focus more on cost minimization than on catch maximization. Hence, more overall fleet profit should be possible with IFQs. Other complications, such as discards of incidental catches, may still be a barrier to ideally efficient operation. Consequently, the profit generated by a fleet under limited access may approach, but would likely fall short of, the maximum possible.

Enforcement and administrative issues

In Chapter 6 Dorothy Lowman summarizes the major enforcement and administrative problems that are likely to arise under license limitation or IFQ systems. She also reviews the world experience with IFQ systems, providing some guidance on what conditions make enforcement and administration more or less difficult, and reports on an effort to determine what would be required to implement limited access in the Pacific groundfish fishery. With regard to license limitation, the main requirements are for maintenance and frequent updating of records on license ownership and for an appeals mechanism to handle disputes on initial allocation and any subsequent license revocations. To limit the administrative effort in settling appeals of initial allocations, the criteria for inclusion or exclusion should be as objective and specific as possible. It would be advisable to avoid, for example, a vague criteria crediting fishermen for past participation during years they did not fish due to "unavoidable circumstances" (from Alaska's first limited entry regulation).

Enforcement and administration of license limitation for Pacific groundfish would be relatively simple and inexpensive because it would involve only a slight extension of existing licensing efforts. All commercial fishermen are already licensed and vessel owners are required to display their commercial vessel registration numbers. To enforce a license limitation for groundfish, enforcement agents suggest the requirement that permits be carried and openly displayed onboard vessels to facilitate at-sea monitoring. The moderate cost of maintaining updated records of license transfers and operating an appeals board for a license limitation program might be covered by a $100 per year fee as suggested in the proposal from the Fishermen's Marketing Association.

Administration and enforcement of IFQs would be a more difficult undertaking. Based upon experience elsewhere, the initial allocation of quotas would most likely mimic past harvest shares, and actual landings of each licensed vessel would have to be monitored for quantity and species composition. This would require better recordkeeping than that needed to establish the simple fact of past participation. The quantities determined by the agency would open another avenue for appeals. In both New Zealand groundfish and Australian bluefin tuna, a substantial number of fishermen did appeal their initial allocation of quota shares. Again, the more objective and specific the criteria used to determine quantitative shares, the less administrative effort will be required to start-up the program.

Enforcement may be the "Achilles heel" of the IFQ system. During the fishing season, each vessel's landings of each species covered by the quota system will need to be recorded and monitored. The difficulty of accomplishing this at reasonable cost will depend upon the (1) number of unloading points used by the fleet; (2) number of individual landings made by vessels; (3) amount of processing required to produce the final product; (4) market structure of the processed fish; (5) credibility of the enforcement program; and (6) degree of social disruption caused by the IFQ program. Based on a review of world experience with IFQ systems, Dorothy Lowman notes that with fewer ports involved and with less frequent deliveries, the enforcement of landings quotas would be simpler and easier. Where the fish go through an extensive processing chain (e.g., frozen fish fillets versus fresh salmon) and where the marketing chain is concentrated in the hands of a few firms or goes through a central inspection process (e.g., New Zealand groundfish), monitoring of actual landings is made easier and more credible.

To minimize the illegal landing of fish, the enforcement agents contacted during the study suggested that an official coupon be issued for each quota share, and that these coupons be relinquished at the time of landing or upon transfer of the shares to another vessel. Other suggestions included a declaration of intended landing 3 hours prior to arrival in port, and the levying of stiff penalties for noncompliance. Most enforcement agents also insisted that records of vessel landings under an IFQ system would need to be available on a weekly or semiweekly basis. While this would be a new burden on the data collection and reporting system, it is probably feasible to overcome the data flow problems by placing port agents on a computer hook-up.

Legal issues and requirements

Chapter 7 contains Dorothy Lowman's review of legal mandates and concepts that need to be taken into consideration in designing a limited access system. The Magnuson Fisheries Conservation and Management Act permits regional fishery councils to include limited access measures in their fishery management plans if they satisfy certain criteria. The councils must take into account, for example, present participation in the fishery, historical fishing practices in and dependence on the fishery, economics of the fishery, and the cultural and social framework relevant to the fishery. How these factors are to be taken into account is not laid out in detail. The two federal programs approved so far (a moratorium on the Mid-Atlantic Council's surf clam and ocean quahog fishery and a troll salmon license limitation program implemented by the North Pacific Council) demonstrate the feasibility of meeting the criteria. It is necessary that a Council's record of deliberations show that the criteria were considered.

Constitutional requirements are also important. The limited access system must recognize the right of due process, the right to equal protection, the provision that no undue discrimination occur between residents of different states, and that no excessive burden be placed upon interstate commerce. Again, the administrative record needs to show that these requirements were recognized and considered in implementing the program. Another issue is the taking of property without just compensation. Under an IFQ system, the management council may wish to decrease total harvests by reducing the individual's allotted quantitative harvest share. Careful legal

analysis needs to be applied to assure that a proposed IFQ does not create a property right which, if altered, would have to be compensated. This might be avoided, for example, by carefully stating that the shares are subject to modification based on legitimate management needs.

A wide variety of other laws place various requirements and restrictions upon fishery management provisions, and these need to be considered in limited access as well. The principal laws reviewed in Chapter 7 include the Regulatory Flexibility Act, Executive Order 12291, the National Environmental Policy Act, the Coastal Zone Management Act, the Administrative Procedures Act, the Endangered Species Act, and the Marine Mammal Protection Act. The need to show compliance with these other applicable laws should not prove to be a barrier to implementing limited access systems.

POSTSCRIPT

While this study was underway, two national studies of fishery management have given greater prominence to the discussion of limiting access to fisheries. The American Fisheries Society's ad hoc Committee on Federal Fisheries Responsibilities, chaired by John Harville, recommended that "...the American Fisheries Society should endorse the concept of controlled access for fisheries, to include use where appropriate of such management tools as license limitation, individual fishermen quotas, or other measures designed to avert the 'tragedy of the commons'" (Harville 1986, p. 4). The Committee also recommended authorization of userfees or royalties to recover costs of managing fisheries.

The NOAA Fishery Management Study (U.S. Dep. Commer. 1986), written by an eleven-member panel appointed by the Administrator of the National Oceanic and Atmospheric Administration and led by William J. Hargis, Jr., recommended that licenses and fees be established for all fisheries under federal jurisdiction. The licenses would be issued by coastal states. The fees, collected by states but shared with the federal government, would help to improve fisheries, including research, data collection, enforcement, and habitat improvement. The NOAA study also states that "Limited entry, rights to the opportunity to fish through individual quota shares, lotteries or some other means **must** be implemented." (Emphasis added.) During the discussion of these two reports, the present study of Pacific coast groundfish should provide a useful starting point for more detailed, practical discussion of modified fisheries management institutions.

As noted in the Preface to this report, the Working Group on Limited Access Alternatives was assisted by a Groundfish Alternatives Management advisory group (GAM, for short) made up of industry and state fishery agency personnel. During the lengthy discussions between Working Group and GAM members, several important issues seemed to draw the most consistent attention. In this postscript I will highlight some of those considerations that occur to me of most general interest. Although there are no real surprises here, it may prove instructive to future developers of fishery regulations.

First, many GAM members expressed support for the process which combined a working group to write this report with an advisory group to review and comment on the report. The extended time from beginning to end of the study and the number of hours spent together by the two groups served to increase the value of this consultation. The industry people needed time and detailed review of fundamental concepts before they were prepared to seriously consider altered management arrangements such as IFQs. It also took ample time for Working Group members to understand some of the industry concerns. Although it may seem trite, a degree of trust and openness in the discussion is necessary for learning to occur, and this develops as the participants become familiar with one another, learn many unfamiliar terms, and absorb the background information. Future limited access proposals for consideration by management agencies will need to draw upon both the management specialists and the industry spokesmen who are capable of talking in each others' terms.

Limited access is extremely malleable. It ranges from private property rights (e.g., simple ownership of land) to simple group membership rules for common property resources (e.g., most fishery license limitations). The flexibility it offers regarding transferability, scope, nature of rights and so forth, permits a limited access system to meet most objections that managers and fishermen express. Early in the consultations some GAM members had experience with only a particular license limitation program that, in their view, had serious defects. This limited experience proved to be an initial stumbling block in our discussions. After seeing the broader set of alternatives and reviewing worldwide experience with limited access, some fishermen who were initially adamantly opposed to any form of limited access became interested in discussing the merits of various options. The combination of flexibility in program design and thorough consultation with affected parties should contribute to successful implementation of limited access programs.

While much of the academic and economic discussion focuses on the economic efficiency of fishery management under limited access, current participants tend to concern themselves with the resulting distribution of the wealth (commonly known as "allocation"). People with financial or other interests in the fishery fear that future incomes or fishing opportunities will be jeopardized, possibly due to unforeseen complications in the bureaucratic process. Also, there are those who feel transferable license prices represent an undeserved windfall gain to original license holders. If, as Peter Pearse has suggested, equity is more important than efficiency in developing a license limitation system, a first priority should be to resolve this issue early by establishing what each user group is likely to sacrifice and what each is likely to gain.

Another equity issue is that of market concentration. Consolidation of licenses or IFQs in the hands of a few owners may provide a new avenue for economic control of the fishery. Fear that individual vessel operators may lose their independence to a kind of "company town" arrangement with larger fish companies is not uncommon. Another is that lending institutions and insurance companies may use the individual, transferable license as a tool to control or collect payments from individual fishermen. These fears may be quelled by careful development of restrictions on the transfer and ownership of licenses and individual quotas. But any such restrictions must be viewed from both sides; they may prevent potential inequities, but they also limit the freedom of action for owners of permits.

Another issue of substantial interest was the possibility of using limited access to reduce the wide swings in profitability and fleet size that have recently plagued the groundfish fishery. As one industry member complained, during the boom and bust of 1977-82, many good fishermen making apparently good business decisions were going broke through no fault of their own. As described in Chapter 2, this was partly due to swings in abundance of pink shrimp and rockfish and unfulfilled expectations regarding the developing Alaska groundfish fishery, as well as the standard financial dif-

ficulties associated with high mortgage interest and reduced fish prices. Although most agreed that vessel operators should risk bankruptcy as a result of bad decisions, the effects of economic competition would have been more productive if open access had not permitted so many new vessels to be built (with federal construction subsidies) and so many trawl vessels to migrate to the Pacific coast during years of good pink shrimp fishing. By placing a more-or-less rigid ceiling on total level of participation, a limited entry system would stabilize the fishing fleet size, thus avoiding the highly visible periods of widespread bankruptcy in the fishery. Some industry members look at this stabilization as a legitimate function of government.

Where do we go from here? The Working Group effort was not designed to recommend a program of limited access in the Pacific coast fishery, and this report reflects that fact. It is nevertheless useful to describe some promising approaches. A license moratorium such as the one originally developed by the Fishermen's Marketing Association and Coast Draggers Association could provide a temporary limit on new entry while a more extended discussion of the eventual system proceeds. In fact, this was the intent of that proposal. This approach worked in the California salmon troll fishery, where the industry became actively involved in developing a partially transferable vessel license program after the fishermen's license moratorium was put into effect. It recently failed, however, when attempted by the North Pacific Fishery Management Council in the Alaska halibut fishery. Strong opposition by key elements of the industry was the underlying reason for disapproval of the proposed halibut program.

Other observers of license limitation programs warn that the first step often becomes the final step; a hastily designed, temporary measure can slide into permanency despite original intentions of the managers. This observation could lead one to recommend development of a comprehensive and permanent system at the outset. To do so would require extraordinary skill and prescience. On the other hand, worldwide experience of limited access programs (see Mollett 1986) suggests that most programs were repeatedly amended to deal with evolving problems and conditions. Also, the need for widespread participation in decision making makes it impossible to assemble a fully developed limited access program within management circles before opening the discussion to industry and public scrutiny. One way to avoid the horns of this dilemma would be to include in an initial, temporary program a requirement that a complete and comprehensive system be developed and implemented by a fixed date.

A test of the individual quota share approach would be feasible on a limited part of the fishery. Some of the industry spokesmen were quite leery of Individual Fishermen Quotas, both because they may be difficult to enforce and because they might cause an increase in discards of fish. Whether or not discards would be a major problem seems to depend upon two major factors: (1) whether a good market for quotas develops; and (2) whether the fish is normally caught in combination with others. On the assumption that it would be best to test the system in small steps, it would be logical to try IFQs for a species like widow rockfish, where incidental catch of other species is not a serious problem. This would require only minimal new enforcement effort, since trip limits, which necessitate monitoring of an individual vessel's landings per trip, are already in effect on widow rockfish. The major tasks would be to determine initial quotas, develop the enforcement procedures, and establish a market for quotas that allows fishermen to buy and sell harvest rights to meet their changing needs. A thorough test of this sort would generate invaluable information and would undoubtedly reveal additional problems that are not currently anticipated.

In sum, the consideration of limited access for commercial fisheries involves fishery management and industry participants all around the nation. Limited access covers a broad array of approaches that need to be specifically tailored to local circumstances, probably through intense involvement of industry and management agency personnel. The more common license limitation systems have achieved only very limited objectives to date, but the advantages of individual quotas are based more on theory than experience. Hence, some limited test cases may be a profitable way to begin learning more about the quota share systems.

Finally, no matter what form of limited access is implemented, it will not normally deal with all the objectives of fishery management. Overcapacity and overfishing can be controlled through limiting access, but user conflicts, size-at-capture, and other considerations will continue to require attention through traditional forms of regulation. Limited access can be a very powerful force for efficiency and stability in commercial fisheries, but it is not a panacea. Research and development, possibly through adoption of test cases as suggested above, should continue so that we can apply this management tool appropriately and beneficially.

Citations

ACHESON, J. M.
1975. Fisheries management and social context: the case of the Maine lobster fishery. Trans. Am. Fish. Soc. 104(4):653-668.

ADASIAK, A.
1978. The Alaskan experience with limited entry. *In* Rettig, R. B., and J. J. C. Ginter (eds.), Limited entry as a fishery management tool, p. 271-299. Univ. Wash. Press, Seattle.

ARNASON, R.
1986. Management of the Icelandic demersal fisheries. *In* Mollett, N. (ed.), Fishery access control programs worldwide, p. 83-102. Alaska Sea Grant Rep. 86-4. Univ. Alaska, Fairbanks.

CLARK, C. W.
1980. Towards a predictive model for the economic regulation of commercial fisheries. Can. J. Fish. Aquat. Sci. 37:1111-1129.

CLARK, I. N., and A. J. DUNCAN.
1986. New Zealand's fisheries management policies—Past, present and future. The implementation of an ITQ based management system. *In* Mollett, N. (ed), Fishery access control programs worldwide, p. 107-140. Alaska Sea Grant Rep. 86-4. Univ. Alaska, Fairbanks.

DEWEES, C.
1985. Technical innovation in the Pacific coast commercial trawling and salmon trolling fisheries. Ph.D. thesis, Univ. Calif. Davis.

FRASER, G. A.
1978. License limitation in British Columbia salmon fishery. *In* Rettig, R. B., and J. J. C. Ginter (eds.), Limited entry as a fishery management tool, p. 358-381. Univ. Wash. Press, Seattle.
1979. Limited entry: experience of the British Columbia salmon fishery. J. Fish. Res. Board Can. 36:754-763.

HARVILLE, J. P.
1986. Summary report and recommendations, AFS Committee on Federal Fisheries Responsibilities. Fisheries (Bathesda) 11(4):2-6.

HUPPERT, D. D.
1979. Implications of multipurpose fleets and mixed stocks for control policies. J. Fish. Res. Board Can. 36:845-854.

HUPPERT, D. D., C. THOMSON, and S. IACOMETTI.
1984. A report on the 1981 PACFIN research data base. Admin. Rep. LJ-84-03, Southwest Fish. Cent., Natl. Mar. Fish. Serv., NOAA, La Jolla, CA 92038.

HUPPERT, D. D., and C. THOMSON.
1985. Annual report on PACFIN research data base—1982. Admin. Rep. LJ-85-12, Southwest Fish. Cent., Natl. Mar. Fish. Serv., NOAA, La Jolla, CA 92038.

HUPPERT, D. D., and D. SQUIRES.
1986. Potential economic benefits of limited access in the Pacific coast trawl fishery: a linear programming approach. Admin. Rep. LJ-86-01, Southwest Fish. Cent., Natl. Mar. Fish. Serv., NOAA, La Jolla, CA 92038.

KEEN, E. A.
1973. Limited entry: the case of the Japanese tuna fishery. *In* Sokoloski, A. A. (ed.), Ocean fishery management: Discussions and research, p. 146-158. U.S. Dep. Commer., NOAA Tech. Rep. NMFS CIRC-371.

KOCH, C.
1985. Legal tools and restrictions affecting fisheries management. *In* Proc., Conference on Fisheries Management Issues and Options, p. 149-164. Alaska Sea Grant Rep. 85-2, Univ. Alaska, Fairbanks.

KORSON, C. S., and W. SILVERTHORNE.
1985. Economic status of the Washington, Oregon and California groundfish fishery. NOAA Tech. Memo. NOAA-TM-NMFS-SWR-010. Southwest Fish. Cent., Natl. Mar. Fish. Serv., La Jolla, CA 92038.

LILBURN, B.
1986. Management of Australian fisheries: Broad developments and alternative strategies. *In* Mollett, N. (ed.), Fishery access control programs worldwide, p. 141-187. Alaska Sea Grant Rep. 86-4, Univ. Alaska, Fairbanks.

MacGILLIVRAY, P.
1986. Evaluation of area licensing in the British Columbia roe herring fishery, 1981-1985. *In* Mollett, N. (ed.), Fishery access control programs worldwide, p. 251-274. Alaska Sea Grant Rep. 86-4, Univ. Alaska, Fairbanks.

MEANY, T. F.
1978. Restricted entry in Australian fisheries. *In* Rettig, R. B., and J. J. C. Ginter (eds.), Limited entry as a fishery management tool, p. 391-415. Univ. Wash. Press, Seattle.

MILLER, R.
1984. Remarks at Limited Entry Workshop, Kailua-Kona, Hawaii, Aug. 18, 1984, sponsored by W. Pac. Reg. Fish. Manage. Counc., Honolulu, HI 96813. (Transcript)

MOLLETT, N. (editor).
1986. Fishery access control programs worldwide. Alaska Sea Grant Rep. 86-4, Univ. Alaska, Fairbanks, 366 p.

PACIFIC FISHERY MANAGEMENT COUNCIL.
1982. Fishery management plan for Pacific coast groundfish. Pac. Fish. Manage. Counc., Portland, OR 97201.
1985. Status of the Pacific coast groundfish fishery through 1985 and recommended acceptable biological catches for 1986. Pac. Fish. Manage. Counc., Portland, OR 97201.
1986. Status of the Pacific coast groundfish fishery through 1986 and recommended acceptable biological catches for 1987. Pac. Fish. Manage. Counc., Portland, OR 97201.

PACFIN (Pacific Coast Fisheries Information Network).
Pacific Fishery Management Council groundfish monthly reports. Pac. Mar. Fish. Comm., Portland, OR 97201.

PEACOCK, G. F., and D. A. MacFARLANE.
1986. A review of quasi-property rights in the herring purse seine fishery of the Scotia-Fundy region of Canada. *In* Mollett, N. (ed.), Fishery access control programs worldwide, p. 215-230. Alaska Sea Grant Rep. 86-4, Univ. Alaska, Fairbanks.

PEARSE, P. H.
1982. Turning the tide: A new policy for Canada's Pacific fisheries. Final Rep., Commission on Pacific Fisheries Policy, Vancouver, B.C., Canada.

RETTIG, R. B.
1984. License limitation in the United States and Canada: an assessment. N. Am. J. Fish. Manage. 4:231-248.

ROBINSON, W.
1986. Individual transferable quotas in the Australian southern bluefin tuna fishery. *In* Mollett, N. (ed.), Fishery access control programs worldwide, p. 189-206. Alaska Sea Grant Rep. 86-4, Univ. Alaska, Fairbanks.

ROLPH, E. S.
1983. Government allocation of property rights: Who gets what? J. Policy Anal. Manage. 3(1):45-61.

SCHELLE, K., and B. MUSE.
1984. Buyback of fishing rights in the U.S. and Canada: Implications for Alaska. Alaska State Commer. Fish. Entry Comm. Policy Discussion Paper, Juneau.

STOKES, R. L.
1983. Limited entry in the Pacific halibut fishery: the individual quota option. Doc. 20, N. Pac. Fish. Manage. Counc., Anchorage, Alaska.

TOWNSEND, R. E.
1985. On "capital-stuffing" in regulated fisheries. Land Econ. 61(2):195-197.

U.S. DEPARTMENT OF COMMERCE.
1986. NOAA Fishery Management Study. Wash., D.C., 63 p.

Appendix A

Elements of Proposal for a Groundfish Trawl License Moratorium by the Fishermen's Marketing Association[1] and Coast Draggers Association[2]

1. A trawl license moratorium would be established by legislation in the states of California, Oregon, and Washington which would create a groundfish trawl license and simultaneously place a moratorium upon their issuance. The legislation would become effective only when all three states have adopted similar legislation.

2. A regional groundfish trawl license would be established with the license assigned to a particular vessel. This license would allow the vessel to operate in the waters adjacent to, and deliver groundfish to the states of, Washington, Oregon, and California. The license may be transfered with sale of the vessel.

3. A tri-state industry governing Board should be established, composed of one person representing the directors of the three state fisheries departments and nine active trawl vessel owners. The directors' representative should act as chairman of the Board and vote only in case of a tie. The person selected to represent the directors should rotate annually amongst the three states. There should be three vessel owners selected by the Governor or Fisheries Director of each state. The selection should be made from a list of names submitted by a trawl association or individuals at large. The vessel owners should serve three-year terms staggered on one-year intervals.

A quorum for the Board should consist of five vessel owners with at least one vessel owner from each state present. Actions requiring the approval of a vote should pass with a simple majority of members present.

4. Funding for the administration and costs of Board meetings should be covered by the levy of a flat fee of $100 per vessel. This fee should be collected when the vessel owner purchases his commercial license.

5. In order to receive a license, a vessel must meet an initial qualification of either delivering 100,000 pounds of groundfish or making at least 12 deliveries of groundfish during one year using legal trawl gear for groundfish as defined by the Pacific Coast Groundfish Management Plan. This qualification cannot be met by delivering incidentally caught groundfish from another fishery.

6. In order to maintain a license, a vessel must continue to meet the initial qualification of 100,000 pounds or 12 deliveries on an annual basis. If a vessel owner knows beforehand that his boat will not be able to meet the continuing qualifications because of removal of the vessel from the groundfish fishery into another fishery, he may request an exemption from the governing Board in advance.

7. Individuals with a contract signed during 1984 or who have begun new construction or conversion during 1984 shall qualify for a license. However, the governing Board must first verify the validity of such contracts for initiation of construction or conversion.

8. The governing Board may grant licenses to anyone based upon prior involvement in the fishery, provided they have remained active in the trawl fishery in the Northeast Pacific or Bering Sea and they appeal for the license during the first year of this moratorium.

9. Unconditional replacement of vessels should be allowed. Replacement of vessels lost due to sinking or the desire to upgrade or downgrade should be allowed. If a person wishes to upgrade or downgrade with a second vessel, the original vessel must be removed from the fishery.

10. The size and condition of the fleet should be reviewed annually. The size of the fleet will slowly decrease through attrition. An annual review should establish if the fleet is higher than, equal to, or below the optimum level in relationship to stock size and market demand.

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